

## IMPORTANT

Installers' Information Manual, Users' Information Manual, Wiring Diagram, Parts List and Warranty are inside or attached and should be read before the Installation is started or before service is attempted.

After factory final assembly, this furnace has been dielectrically tested. Operation tests have been performed on the burners, fan control and blower motor.

**- TO THE INSTALLER -**  
**AFFIX THIS PACKET ADJACENT TO**  
**THE FURNACE.**

**- TO THE OWNER -**  
**RETAIN THIS PACKET AND ITS CONTENTS FOR**  
**FURTHER REFERENCE.**

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INSTALLERS' INFORMATION MANUAL

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#### USER'S MANUAL

(PRINTED IN RED AND BLACK AND INSERTED IN THE CENTER OF THIS PACKET.)

A-VERSION

DIFFERENCE BETWEEN A-1 AND A-2 IS THE  
LATE 1960S BETWEEN A-1 AND A-2 IS THE  
LATE 1960S DIFFERENT FOR EACH

MANUAL PACKET 403293 A  
INSTRUCTION ASSEMBLY 408310 B  
COVER ASSEMBLY 408303 A

# PARTS

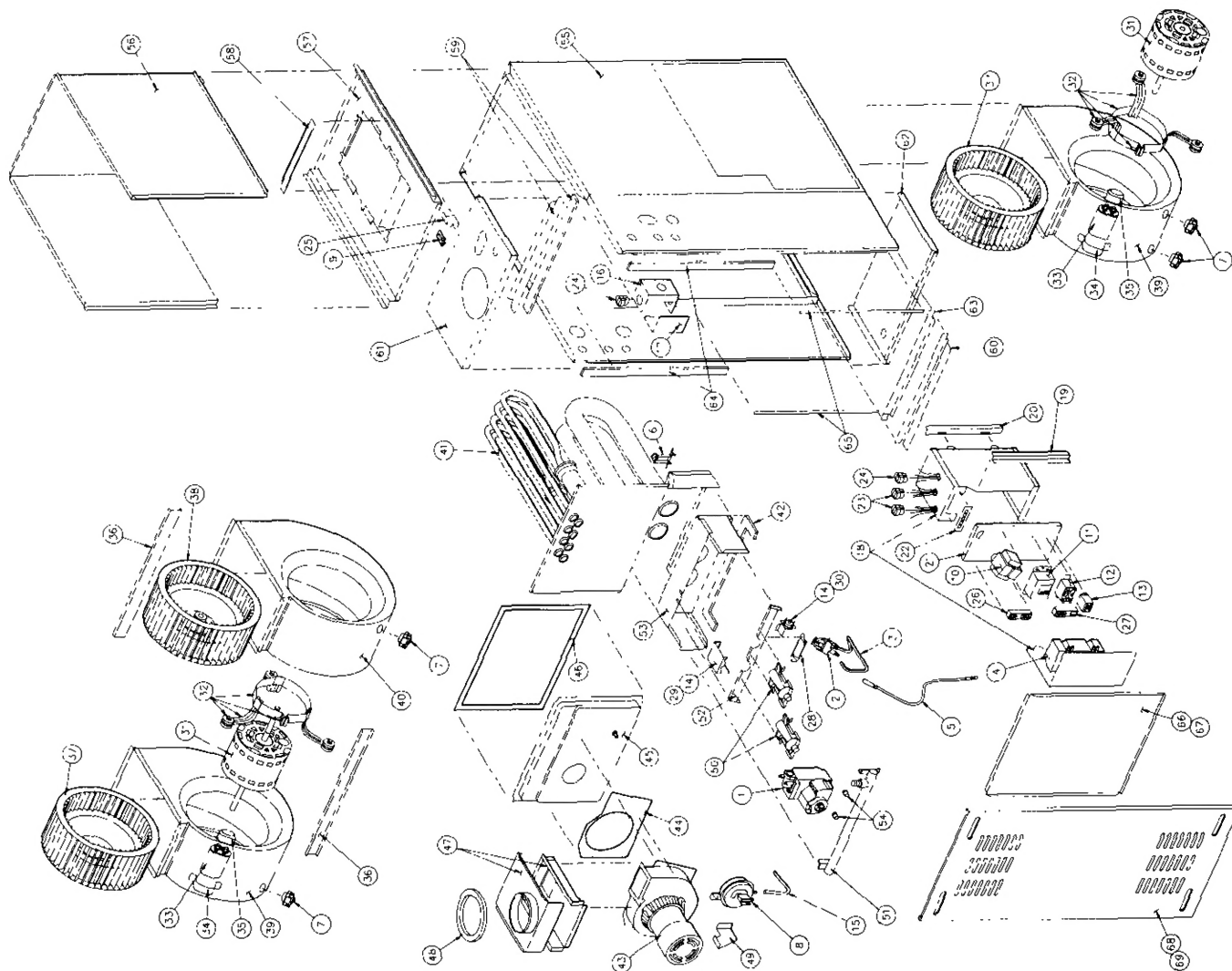
## FUNCTIONAL PARTS LIST

The format of this parts list allows you to get the part number quickly. It allows you to easily identify the part and the part number. Propane Conversion Kit and Filter Frames are also listed in the parts list.

If you do not know the part number, find the part illustration to the left and note the illustration number. Locate the illustration number in the Parts List on the back foldout of this packet. Read across the list to locate the part number for the appropriate size furnace.

**EXAMPLE:** You need an inducer motor relay for a 60,000 BTUH input 1/3 H.P. furnace:

1. Find the inducer motor relay in the illustration and get the illustration number (In this case 13).
2. Go to the table and read down to illustration number 13.
3. Read across the row to find the part number for the 60,000 BTUH input 1/3 H.P. furnace.
4. Read part number 9043-316.



# INSTALLERS' MANUAL



## INFORMATION

To assure both safe and proper operation, please carefully follow the instructions in this manual to correctly install this new furnace.

**ATTENTION, INSTALLER!** After installing furnace, give the user:

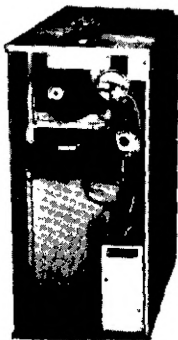
- Users' Information Manual
- Parts List
- Installers' Information Manual
- Warranty Information

**ATTENTION, USER!** Your furnace installer should give you the above four important documents relating to your furnace. Keep these as long as you keep your furnace. Pass these documents on to later furnace purchasers or Users'. If any of the four documents is missing or damaged, contact your installer or furnace manufacturer for replacement. For efficient service, please give your furnace model and serial number, listed in Section 1 of your Users' Information Manual or from your furnace rating plate. Throughout this Installers' Information Manual, we frequently use the word "you" when referring to the person responsible for application, installation and service of your furnace. Please remember to have only qualified service technicians perform these services.

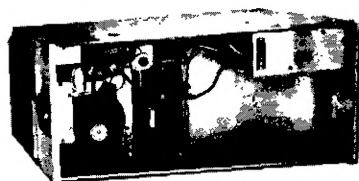
**WARNING:** Individuals who install this furnace, must have the training and experience necessary to install gas furnaces. They must also have training and experience necessary to install related comfort air conditioning appliances. Improper installation could create a hazard, resulting in damage, injury or death.

While we have written these instructions as accurately and thoroughly as possible, they may not cover every system variation or contingency. Also, questions of interpretation may arise. For more information, solutions to particular problems or clarification, contact your local distributor or the manufacturer. See the furnace rating plate for who to contact.

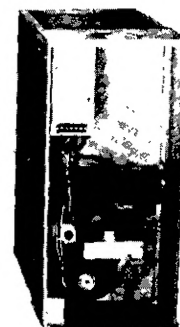
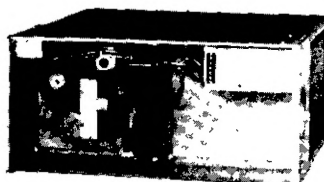
Furnace installation must follow all applicable NATIONAL, STATE and LOCAL CODES.



UPFLOW



HORIZONTAL



DOWNFLOW

### ELECTRONIC IGNITION INDUCED DRAFT FURNACE

**WARNING:** FOR YOUR SAFETY, WHAT TO DO IF YOU SMELL GAS:

- DO NOT TRY TO LIGHT ANY APPLIANCE;
- DO NOT TOUCH ANY ELECTRICAL SWITCH; DO NOT USE ANY PHONE IN THE BUILDING;
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE; FOLLOW GAS SUPPLIER'S INSTRUCTIONS;
- IF YOU CANNOT REACH GAS SUPPLIER, CALL FIRE DEPARTMENT.

**IMPORTANT SAFETY NOTE:** After installing the furnace, show the user how to turn off gas and electricity to furnace. Point out control and switch locations for turning off gas and electricity. Go over Sections 4 and 6 of Users' Information Manual and Section 29 in this manual with user. Make sure user understands the importance of following all safety precautions.

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## SECTION 1 — PREPARING TO INSTALL FURNACE.

### A. Literature.

Review this manual, Users' Information Manual and Parts List. In particular, see User's Information Manual and Parts List for location and identification of furnace components.

After installing furnace, give this Installers' Information Manual, Users' Information Manual, Warranty and Parts List to user. You may have questions as you install the furnace. If you need help on any of the installation instructions or other matters relating to the furnace, contact the office where you bought the furnace. You may also refer to the furnace rating plate for a contact name.

### B. Installation Positions.

1. You may install furnace as-shipped in an upflow or horizontal configuration in one of three positions shown in Figure 1.

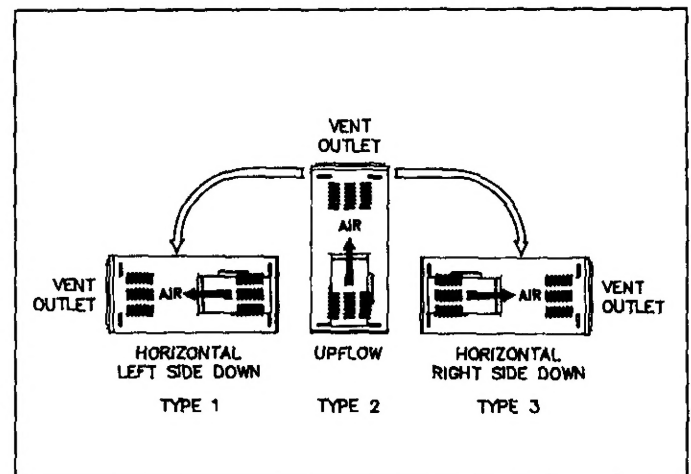


FIGURE 1

2. You may convert furnace quickly and easily from its as-shipped configuration. After conversion, you can install it as a downflow or horizontal furnace in one of three positions shown in Figure 2.



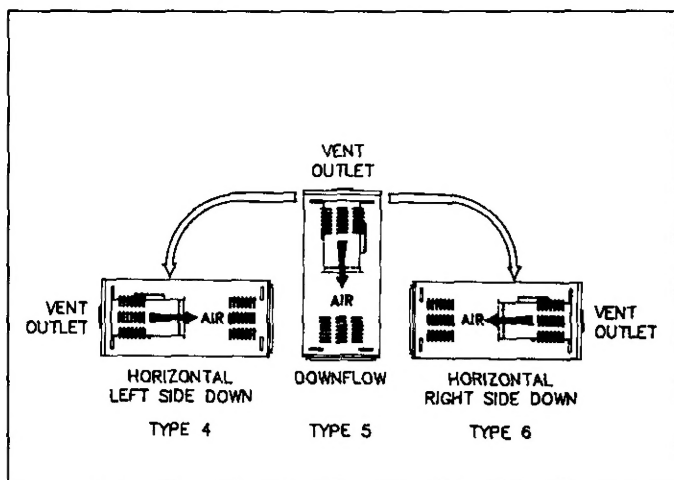


FIGURE 2

## SECTION 2 — IMPORTANT SAFETY RULES.

**WARNING:** Read and exactly follow these rules. Failure to do so could cause improper furnace operation, resulting in damage, injury or death.

### A. Signal words.

To alert you to potential hazards, we use the signal words **"WARNING"** and **"CAUTION"** throughout this manual. **"WARNING"** alerts you to situations that could cause serious injury or death. **"CAUTION"** alerts you to situations that could cause minor or moderate injury or property damage. To help you, we use the words "must" and "should" in this manual. "Must" is mandatory. "Should" is advisory.

- B. Use only the type of gas approved for this furnace; refer to furnace rating plate.

**WARNING:** Only use natural gas in furnaces designed for natural gas. Only use Propane (LP) gas for furnaces designed for Propane (LP) gas. Make sure furnace will operate properly on gas type available to user. Do not use this furnace with butane. Using wrong gas could create a hazard, resulting in damage, injury, or death.

- C. **DO NOT** install this furnace outdoors or in a mobile home, trailer or recreational vehicle. It is not A.G.A. design-certified for these installations. This furnace is suitable for a home built on site or manufactured home completed at final site.
- D. Carefully choose furnace installation site. **DO NOT** directly expose furnace to drafts, wind or other outdoor conditions. See Section 8 for more information.
- E. **DO NOT** install furnace in a corrosive or contaminated atmosphere. Make sure all combustion and ventilation air requirements are adhered to in addition to local codes and ordinances. See Section 8 for more information.
- F. **DO NOT** use this furnace during construction when adhesives, sealers, and/or new carpets are being installed. If the furnace must be used during construction, provide clean outdoor air for combustion and ventilation to furnace space. See Section 8 for more information.

- G. Provide adequate combustion and ventilation air to space where furnace is being installed. See Section 8 for more information. Connect this furnace to an approved vent system, venting combustion products outdoors. See Section 9 for more information.
- H. Never test for gas leaks with an open flame. Use a commercial soap made specifically for leak detection to check all connections. See Section 11 for more information.
- I. Always install duct system with furnace. Be sure duct system has external static pressure within allowable furnace range. See Sections 16 and 25 for more information.
- J. Completely seal supply and return air ducts to furnace casing. Duct work must run to an area outside furnace air space. Seal duct work wherever it runs through walls, ceilings or floors. See Section 16 for more information.

## SECTION 3 — MEETING CODES.

Before installing furnace, make sure you know all applicable codes. National, state and local codes may take precedence over any instructions in this manual. Be sure to consult:

- Authorities having jurisdiction over furnaces;
- Local code authorities for information on electrical wiring, gas piping and vent pipe;
- Current National Fuel Gas Code ANSI Z223.1/NFPA 54;
- Current National Electrical Code ANSI/NFPA 70.

See Section 30 for information on getting copies of these codes.

## SECTION 4 — DETERMINING BEST FURNACE LOCATION.

You may install this furnace as an upflow or downflow furnace in an alcove, attic, basement, closet, garage, or utility room. Install furnace so all electrical components are protected from water.

You may install it as a horizontal furnace in an alcove, garage, attic, basement or crawl space.

Select furnace location to meet all requirements in this manual, making sure to refer to:

- Section 2 for safety rules;
- Section 6 for minimum clearances;
- Section 7 for furnace suspension;
- Section 8 for combustion and ventilation air;
- Section 9 for venting;
- Section 11 for gas piping;
- Section 12 for electrical wiring;
- Section 16 and 25 for duct work;
- Section 17 for filters.

Consult local code authorities for additional location requirements.

Locate the furnace close to the chimney/vent and as near the center of the air distribution system as possible. Install furnace as level as possible.

Provide ample space for servicing and cleaning. Location must allow 30 inches minimum front clearance for service. Always comply with minimum clearances shown on inside of front door. Do not install furnace directly on carpeting, tile or any combustible material other than wood flooring.

**NOTE:** A combustible floor base, available from manufacturer, is required for downflow furnace installation on wood flooring.

## HAZARDOUS LOCATIONS.

When furnace is in a residential garage, it must be installed so that burners and ignition source are located no less than 18-inches above the floor. Also, furnace should be protected from physical damage by vehicles.

When furnace is in public garages, airplane hangers, or other buildings having hazardous atmospheres, install unit in accordance with recommended good practice requirements of the National Fire Protection Association, Inc. See Section 30.

## SECTION 5 — IDENTIFYING FURNACE DIMENSIONS, SPECIFICATIONS, AND POSITION.

A. A unique feature of this furnace is that it may be installed as an upflow furnace, horizontal furnace, or downflow furnace (minor conversion required).

1. Furnace as-shipped is an upflow furnace. Furnace may be installed in this position or may be installed as a horizontal on its right or left side without any conversion. See Figure 1.

2. Furnace as-shipped position may be converted to a downflow furnace by following instructions in B. below. Once conversion is complete, furnace may be installed as a downflow furnace. Furnace may also then be installed as a horizontal on its right or left side. See Figure 2.

**WARNING:** Do not install furnace on its back. Doing so could cause a fire, resulting in damage, injury or death.

See Figure 3 for dimensional drawings and specification table.

### B. Converting furnace from as-shipped configuration.

**READ ALL INSTRUCTIONS THOROUGHLY BEFORE STARTING CONVERSION.**

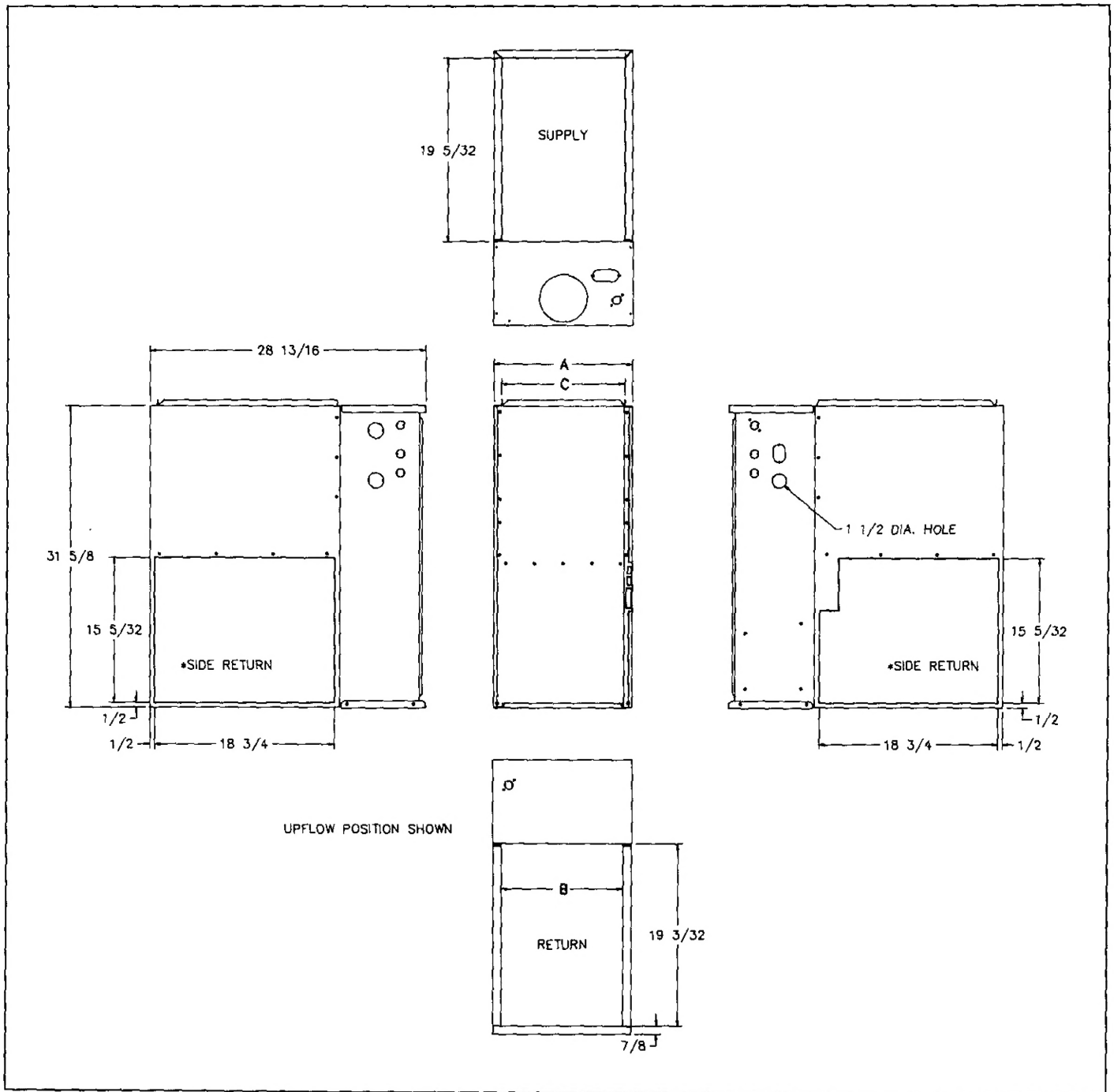
**NOTE:** Start conversion with furnace on its back.

**WARNING:** When servicing controls, all wires must be labeled prior to disconnection. Miswiring can cause improper operation resulting in damage, injury, or death.

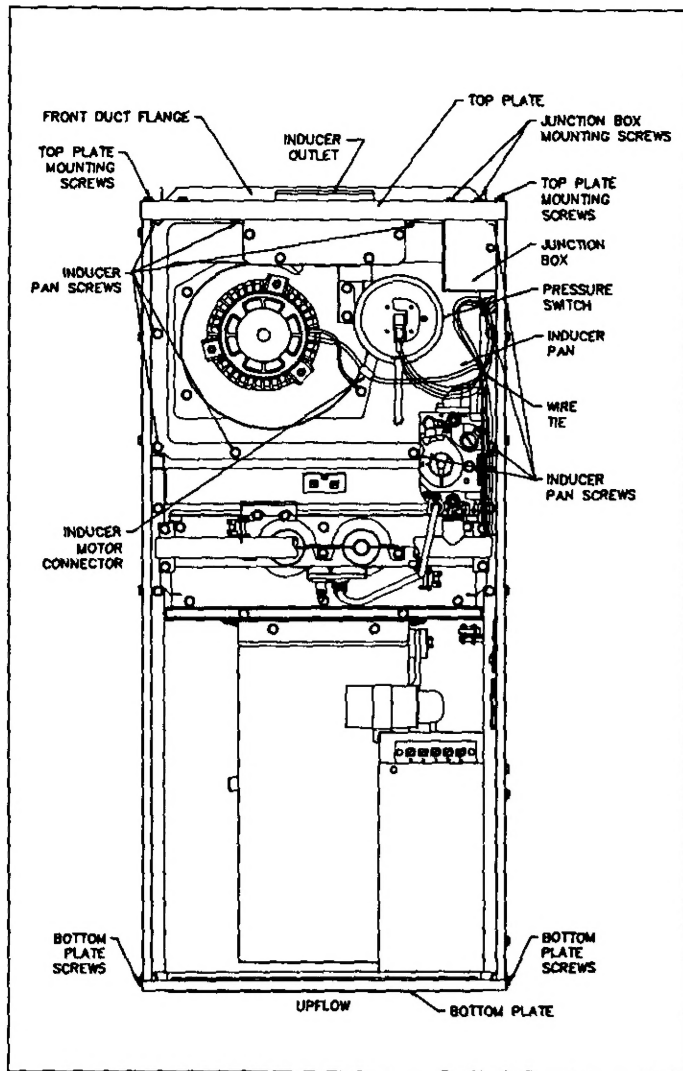
1. Remove front door. Study components described in conversion. See Figure 4.

BTUH* INPUT	MOTOR* H.P.	VENT DIAMETER	FURNACE WIDTH A	RETURN AIR SIZE 18-29/32" X B	SUPPLY AIR SIZE 18-15/16" X C	BLOWER WHEEL SIZE	TEMP RISE °F	CFM at 0.50" W.C.
40,000	1/4	3"	14-1/2	12-7/8"	12-15/16"	10-4	50-80	805
40,000	1/3	3"	14-1/2	12-7/8"	12-15/16"	10-6	30-60	1265
60,000	1/4	4"	14-1/2	12-7/8"	12-15/16"	10-4	45-75	850
60,000	1/3	4"	14-1/2	12-7/8"	12-15/16"	10-6	45-75	1260
60,000	1/2	4"	17-1/2	15-7/8"	15-15/16"	10-8	35-65	1635
80,000	1/4	4"	14-1/2	12-7/8"	12-15/16"	10-4	50-80	915
80,000	1/3	4"	14-1/2	12-7/8"	12-15/16"	10-6	40-70	1235
80,000	1/2	4"	17-1/2	15-7/8"	15-15/16"	10-8	50-80	1645
80,000	3/4	4"	20-1/2	18-7/8"	18-15/16"	(2) 10-4	40-70	1930
100,000	1/3	4"	17-1/2	15-7/8"	15-15/16"	10-6	55-85	1245
100,000	1/2	4"	17-1/2	15-7/8"	15-15/16"	10-8	50-80	1585
100,000	3/4	4"	20-1/2	18-7/8"	18-15/16"	(2) 10-4	40-70	1950
120,000	1/2	5"	20-1/2	18-7/8"	18-15/16"	10-8	45-75	1660
120,000	3/4	5"	20-1/2	18-7/8"	18-15/16"	(2) 10-4	45-75	1965
140,000	3/4	5"	23-1/2	21-7/8"	21-15/16"	(2) 10-4	45-75	1860
140,000	3/4	5"	23-1/2	21-7/8"	21-15/16"	(2) 10-6	50-80	2235

\*See Furnace rating plate located on blower door.

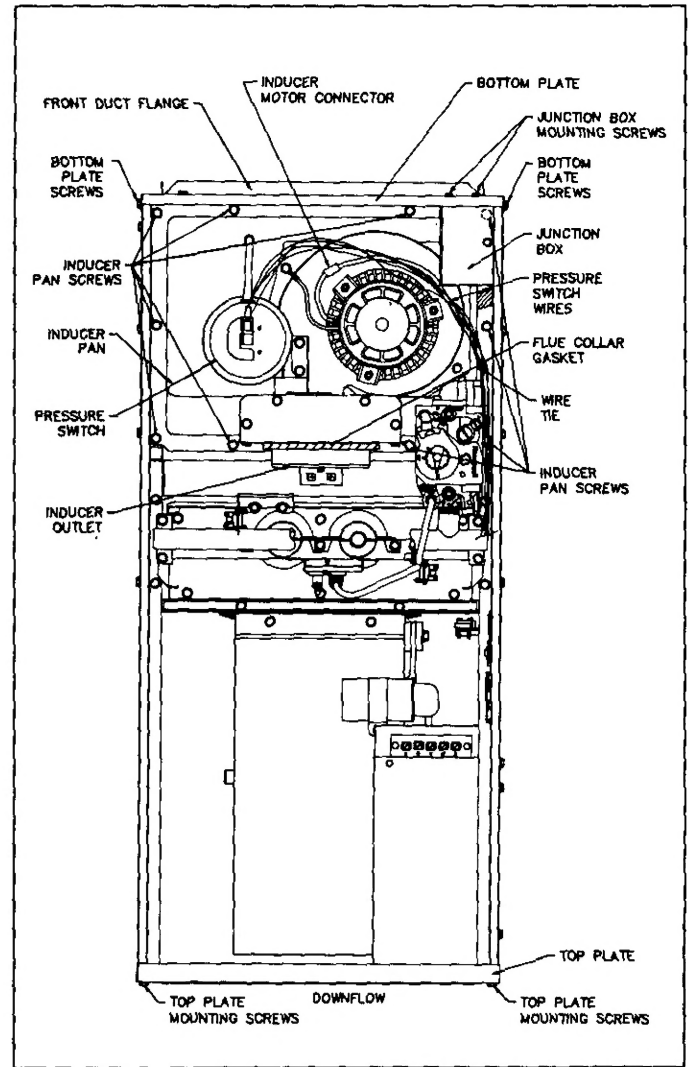


**FURNACE AND DIMENSIONS SPECIFICATIONS  
FIGURE 3**



**AS-SHIPED CONFIGURATION  
FIGURE 4**

2. Remove two junction box mounting screws from top plate. Remove four top plate mounting screws. Save all screws. Remove top plate and front duct flange.
  3. Disconnect pressure switch wires and inducer motor connector wires.
  4. Remove ten screws from the inducer pan; save screws. **DO NOT** drop screws into heat exchanger openings.
  5. Lift inducer pan (with inducer motor and pressure switch still in place) about 1/4 inch and tilt left side up to clear casing flanges. Use care not to damage inducer gasket.
- NOTE:** If possible, decide on direction of gas entry now. Screws to inlet gas valve fitting are accessible. See Section 11.
6. Rotate inducer pan 180 degrees, line up mounting holes and place inducer pan in furnace. Use care not to damage gasket. Replace ten screws in inducer pan. See Figure 5.



**CONVERTED CONFIGURATION  
FIGURE 5**

7. Pressure switch wires will no longer reach pressure switch. Remove cable tie around excess length of red/yellow piggyback, blue and purple pressure switch wires.
8. Connect pressure switch wires as follows. Wires are numbered on insulation near terminals.
  - a. #1 Purple wire to pressure switch, terminal 'C' (Common).
  - b. #2 Blue wire to pressure switch, terminal 'NC' (Normally Closed).
  - c. #7 and #8 Red/Yellow piggyback wire to pressure switch, terminal 'NO' (Normally Open).
  - d. Route all pressure switch wires over inducer motor.
  - e. Reconnect inducer motor connector.
  - f. Replace wire tie in area that prevents wires from touching hot surfaces.

9. Remove four screws that secure bottom plate to casing sides. Remove bottom plate; save screws.
10. Install top plate, removed in step 2, where bottom plate was. Secure with four screws. Inducer outlet is now lined up with vent outlet in top plate.
11. Stand up furnace with top plate down. Line front duct flange up with holes. Place bottom plate on top of duct flange and secure both to casing with four screws.
12. Install junction box on bottom plate using two #6B screws removed in Step 2. Junction box cover and screw of junction box must face front of furnace.
13. Gasket around flue collar must be in place. If gasket is loose, glue it. If gasket is damaged, replace it.
14. Install a single wall vent pipe section (minimum length 30 inches) (Field-Supplied) to inducer outlet with three equally spaced screws. This pipe serves as an inducer outlet extension to which an appropriate vent can be attached. Due to minor variations in vent pipe, available from different manufacturers in the field, and to assure the tightest seal possible, inducer outlet extension is not supplied with furnace. Additional vent pipe sections or Type B1 adapter may then be added when installing the furnace.

**WARNING:** If inducer outlet extension is shorter than 30 inches and chimney or vent becomes blocked, combustion products may be drawn into furnace. This could cause nausea or asphyxiation, resulting in injury or death.

15. Conversion from as-shipped configuration is now complete.

## SECTION 6 — ALLOWING FOR CLEARANCES.

**WARNING:** Do not install furnace on its back, doing so could cause a fire, resulting in damage, injury or death.

Establishing clearances from combustible material.

Locate clearance label on inside of front door. See Figure 6.

**WARNING:** Furnace installation must meet all minimum clearances from combustible material specified in this manual and all applicable codes. Failure to provide required clearance between furnace and combustible materials could cause a fire, resulting in damage, injury, or death.

**WARNING:** This furnace is A.G.A. design certified for direct installation on wood flooring for upflow and horizontal positions.

- Do not install furnace on carpeting, tile or other combustible material.
- Do not install furnace in a closet in horizontal position.
- Do not install furnace on wood flooring without special base in downflow position.

Doing any of the above could cause a fire resulting in damage, injury, or death.

MINIMUM INCHES CLEARANCE TO COMBUSTIBLE MATERIAL IN ALCOVE OR CLOSET.

**UPFLOW POSITION**

TOP	SIDES	BACK	FRONT	VENT
1	1*	0	6	6 WHEN USING SINGLE WALL
1	0	0	2	1 WHEN USING B1

\* FOR CASING WIDTHS 17 INCHES OR LARGER 0 CLEARANCE MAY BE USED. 18 INCH FRONT CLEARANCE REQUIRED FOR ALCOVE. FOR INSTALLATION ON COMBUSTIBLE FLOORING.

---

MINIMUM INCHES CLEARANCE TO COMBUSTIBLE MATERIAL IN ALCOVE OR CLOSET.

**DOWNFLOW POSITION**

TOP	SIDES	BACK	FRONT	VENT
1	1*	0	6	6 WHEN USING SINGLE WALL
1	0	0	2	1 WHEN USING B1

\* FOR CASING WIDTHS 17 INCHES OR LARGER 0 CLEARANCE MAY BE USED. 18 INCH FRONT CLEARANCE REQUIRED FOR ALCOVE. FOR INSTALLATION ON COMBUSTIBLE FLOORING ONLY WHEN INSTALLED ON SPECIAL BASE PART NO. 4024400.

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MINIMUM INCHES CLEARANCE TO COMBUSTIBLE MATERIAL IN ALCOVE.

**HORIZONTAL POSITION**

TOP	SIDES*	BACK	FRONT	VENT
1	2*	0	18	6 WHEN USING SINGLE WALL
1	2*	0	18	1 WHEN USING B1

\* CLEARANCE SHOWN IS FOR AIR INLET AND AIR OUTLET ENDS. VENT MUST MAINTAIN CLEARANCE LISTED ABOVE. FOR INSTALLATION ON COMBUSTIBLE FLOORING.

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FOR HORIZONTAL POSITION LINE CONTACT IS ONLY PERMISSIBLE BETWEEN LINES FORMED BY INTERSECTIONS OF TOP AND TWO SIDES OF FURNACE JACKET AND BUILDING JOISTS, STUDS OR FRAMING.

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ALL POSITIONS REQUIRE 30 INCHES FRONT CLEARANCE FOR SERVICE.

40225

**MINIMUM CLEARANCES  
FROM COMBUSTIBLE MATERIALS  
FIGURE 6**

### 1. Upflow Installation.

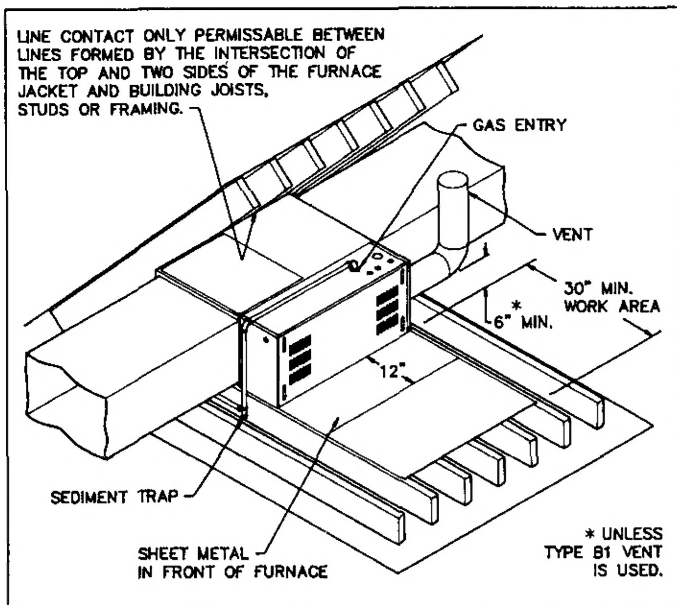
Upflow position is approved for installation on wood flooring. Typical upflow furnace installations are an alcove, attic, basement, closet, garage, or utility room. See Figure 6 or furnace clearance plate for minimum clearances to combustible materials.

### 2. Horizontal Installation

- a. Horizontal position is approved for installation on wood flooring. Typical horizontal furnace installations are an alcove, garage, attic, or crawl space. See Figure 6 or furnace clearance plate for minimum clearances to combustible materials.

#### b. Attic Installation.

Line contact is permissible for furnaces installed in horizontal positions. The intersection of furnace top and sides forms a line. This line may be in contact with combustible material. However, maintain a 6" clearance to vent connection unless Type B1 vent is used. See Figure 7.



**TYPICAL ATTIC INSTALLATION  
FIGURE 7**

When using single wall vent pipe in horizontal installations, horizontal furnaces with 14.50" high casings must be raised 1" to have 6" clearance to combustible material. See Figure 7.

- c. Install a platform under furnace that extends a minimum 30" in front of furnace. This provides a work area and keeps insulating materials away from combustion air openings. Secure platform to joists.

**WARNING:** When a furnace is installed in an attic or other insulated space, keep all insulating materials at least 12" away from furnace and all burner combustion air openings. Failure to do so could cause nausea, asphyxiation or fire, resulting in damage, injury, or death.

- d. Crawl Space Installation.

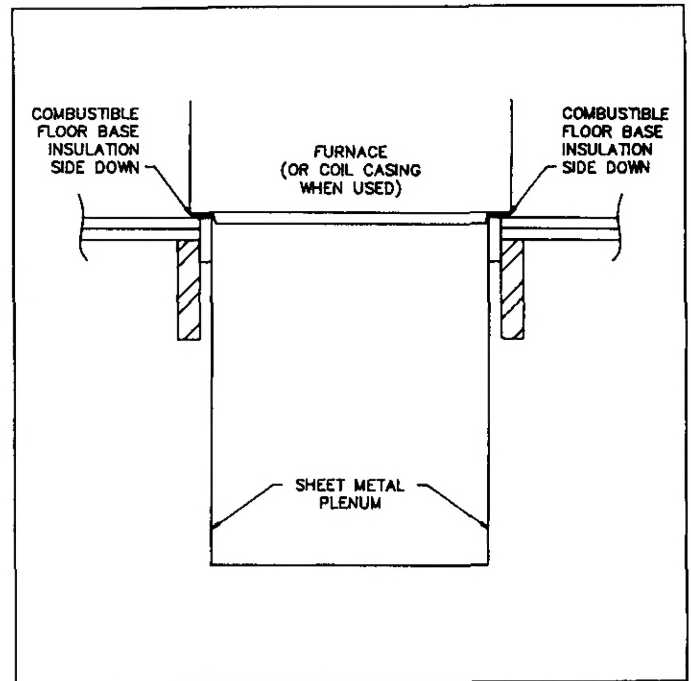
Furnace can be hung from floor joists or installed on suitable blocks or pad. Pad or blocks should provide enough height to reduce potential for water damage. See Section 7.

### 3. Downflow Installation.

You must convert furnace from as-shipped configuration for downflow furnace installation. See Section 5.

Downflow position is approved for installation on non-combustible flooring. Typical downflow furnace installations are an alcove, attic, closet, basement, garage, or utility room. See Figure 6 or furnace clearance plate for minimum clearances to combustible materials.

Furnace installation on combustible flooring is permitted with combustible floor base available from manufacturer. Read installation instructions packaged with combustible floor base to correctly install. See Figure 8.



**DOWNFLOW FLOOR OPENING  
FIGURE 8**

See Figure 9 for installation diagram on combustible floor.

### 4. Service Clearance.

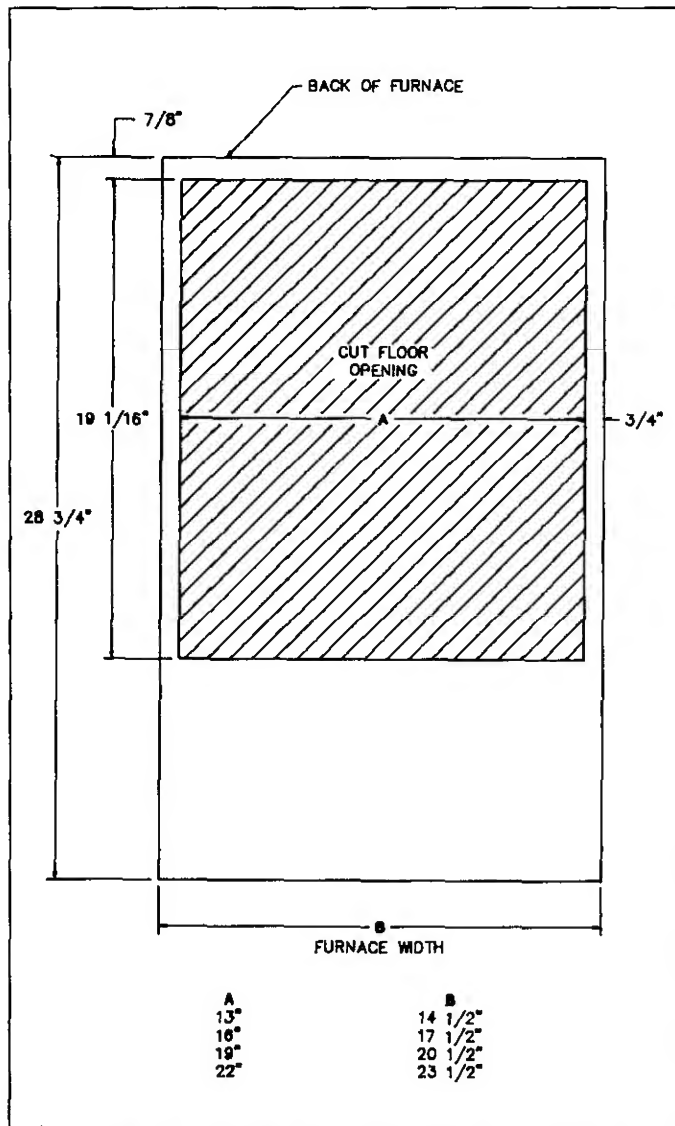
Allow minimum front clearance of 30 inches for service. See Figure 6 or inside of front door for minimum service clearance.

## SECTION 7 — SUSPENDING FURNACE.

Some installations will require that furnace be suspended from rafters or floor joists.

A common way to do this using threaded rods is shown in Figure 10. Consider this means when people may walk underneath furnace. Figure 11 shows another common suspension means using pipe strap. Other means that provide adequate support may be used.

When furnace is not suspended in a crawl space, elevate furnace off ground to avoid water damage and allow for air conditioning coil drain.



FURNACE, PLENUM, AND BASE INSTALLED ON A COMBUSTIBLE FLOOR  
FIGURE 9

## SECTION 8 — PROVIDING FOR COMBUSTION AND VENTILATION AIR.

Before you begin installing furnace, plan to provide enough combustion and ventilation air following:

- Current National Fuel Gas Code ANSI Z223.1/NFPA 54, Section 5;
- Local Code authorities. Refer to Section 31 of this manual for these codes.

Ventilation is the process of replacing air which is required for furnace operation. The total amount of ventilation air provided within structure must equal all requirements of gas appliances in the building, plus any air quantities removed by range hoods, exhaust fans, etc.

Another reason to supply fresh outdoor air for combustion and ventilation is that it dilutes contaminants found in indoor air. These contaminants include bleaches, adhesives, cleaning solutions, detergents, solvents, cat litter, spray can propellants and most refrigerants.

**NOTE:** Level furnace from front to back and from left to right within 1/4" per four feet.

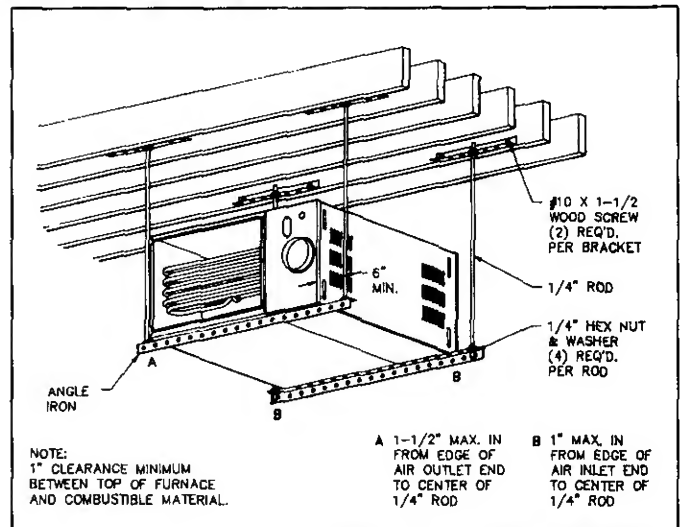


FIGURE 10

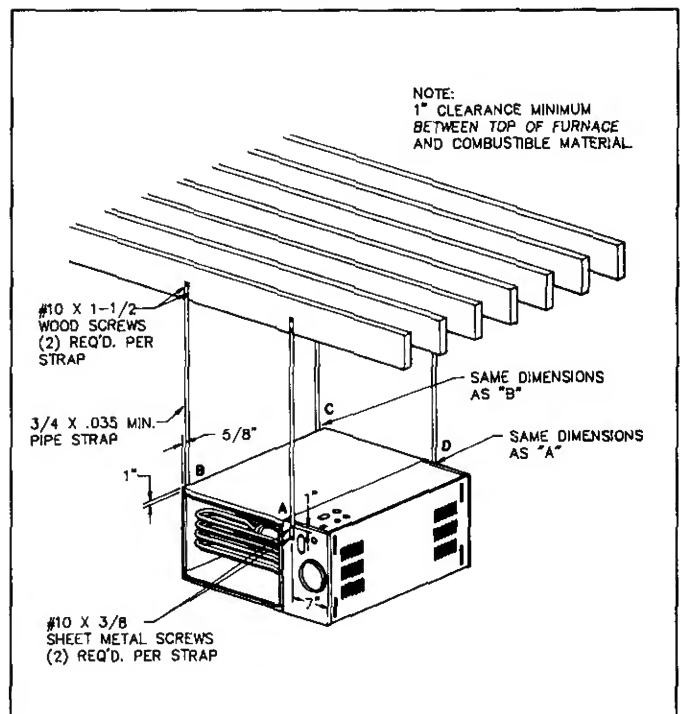


FIGURE 11

**WARNING:** Furnace and any other fuel-burning appliances must have enough fresh air for proper combustion and ventilation. Lack of adequate combustion and ventilation air could cause nausea or asphyxiation, resulting in injury or death.

**WARNING:** During construction, do not use air from inside structure for combustion and ventilation. Vapors from some construction adhesives and materials can become corrosive in the presence of a flame. This could cause failure of heat exchanger or vent system, resulting in damage, injury or death.



**WARNING:** Combustion and ventilation air that contains chlorine, fluorine, bromine and iodine could cause heat exchanger or vent system failure, resulting in damage, injury or death.

**WARNING:** When installing a furnace in an attic or other insulated space, keep furnace free and clear of all insulating materials. Make sure all insulation is at least 12" away from burner combustion air openings and well away from openings into furnace space that supply air for combustion and ventilation. Failure to do this could cause nausea, asphyxiation or fire, resulting in damage, injury or death.

**WARNING:** When installing furnace in an alcove, attic, basement, closet, garage, or utility room do not store items in front of furnace or in front of closet or utility door which would block combustion air openings to furnace. Failure to do this could cause nausea, asphyxiation or fire, resulting in damage, injury or death.

**DO NOT** install furnace where any combustion or ventilation air openings will allow outside air to blow directly against furnace.

**WARNING:** Drafts blowing directly against furnace could cause improper combustion which could cause heat exchanger failure or fire, resulting in damage, injury or death.

Sufficient air **MUST** be provided to insure there will not be a negative pressure in furnace room or space. In addition, there **MUST** be a positive seal between furnace and return air duct to avoid pulling air from burner area.

Provide adequate combustion and ventilation air by considering volume of furnace installation space. Use these instructions and current National Fuel Gas Code ANSI Z223.1/NFPA 54 to determine whether furnace is in an unconfined or confined space.

#### A. Determining if your space is confined or unconfined.

Two factors determine whether a furnace installation space is confined or unconfined:

- Volume of installation space;
- Total gas input of appliances to be installed in that space.

To determine which your space is:

1. First calculate furnace installation space volume in cubic feet.
2. Determine combined input rating (BTUH) of all gas appliances in furnace installation space, including furnace input. This is the total combined input rating.
3. Divide total combined input rating by 1,000. Then divide this number into installation space volume. Here's the formula:

$$\frac{\text{Space Volume}}{\text{Total Input}/1,000} = \text{Ratio}$$

If ratio is less than 50, installation space is a confined space. If ratio is 50 or greater, installation space is an unconfined space.

#### B. Installing furnace in confined space.

**WARNING:** You must provide permanent air openings to a confined furnace installation space from another area as described below. Failure to do so could result in inadequate combustion and ventilation air. These could cause nausea, asphyxiation or fire, resulting in damage, injury or death.

##### 1. Combustion and ventilation air openings.

- a. All combustion and ventilation air from inside the structure.

1. The furnace space must be provided with two permanent openings to an additional room(s) of sufficient volume so that the combined volume of all spaces meet the criteria above for an unconfined space.

The total input of all gas appliances within the combined space must be considered in making this determination. See Figure 12.

2. a. Each opening must have minimum free area of one square inch per 1,000 Btu per hour of the total combined input rating of all gas appliances within the confined furnace space, but not less than 100 square inches. One opening must be within 12 inches of the top and another opening within 12 inches of the bottom of the furnace space. See Figure 12.

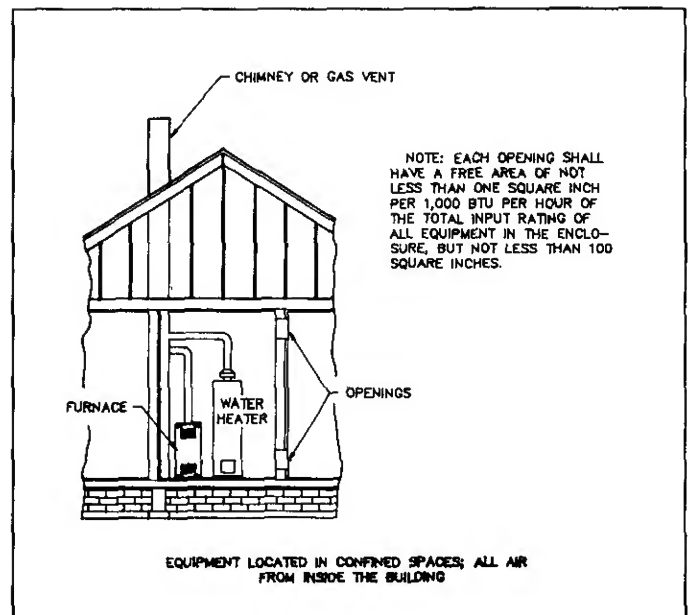


FIGURE 12

For example:

Total Input Btuh	Free Area Per Opening (square inches)
40,000-100,000	100
120,000	120
140,000	140

- b. If building is of unusually tight construction, provide a permanent opening directly communicating with the outdoors. Opening shall have a minimum free area of one square inch per 4000 Btuh of total input rating for all equipment in the enclosure.

If return air is taken directly from hallway or space next to furnace that communicates with furnace spaces, all air for combustion must come from outdoors.

- b. All combustion and ventilation air from outdoors.

1. The furnace space must be provided with two permanent air openings directly to the outdoors, or by ducts to the outdoors or spaces (attic or crawl spaces) that freely access the outdoors. These combustion and ventilation openings will give fresh air free access to furnace space for combustion and ventilation. You must also provide air sufficient for all other gas appliances within furnace space.

Ducts must freely access outdoors or spaces (attic or crawl spaces) which freely access the outdoors. Well ventilated attics or crawl spaces usually satisfy this requirement.

2. Locate one combustion and ventilation air opening within 12" of top of furnace space. Locate another within 12" of bottom of furnace space.
3. When directly accessing the outdoors, each opening must have a minimum free area of one square inch per 4,000 Btuh of total combined input rating of all gas appliances within furnace space. See Figure 13A.
4. If combustion air ducts will run vertically, ducts and each opening must have a minimum free area of one square inch per 4,000 Btuh total combined input rating. You must allow for all gas appliances within the furnace space. See Figure 13B.

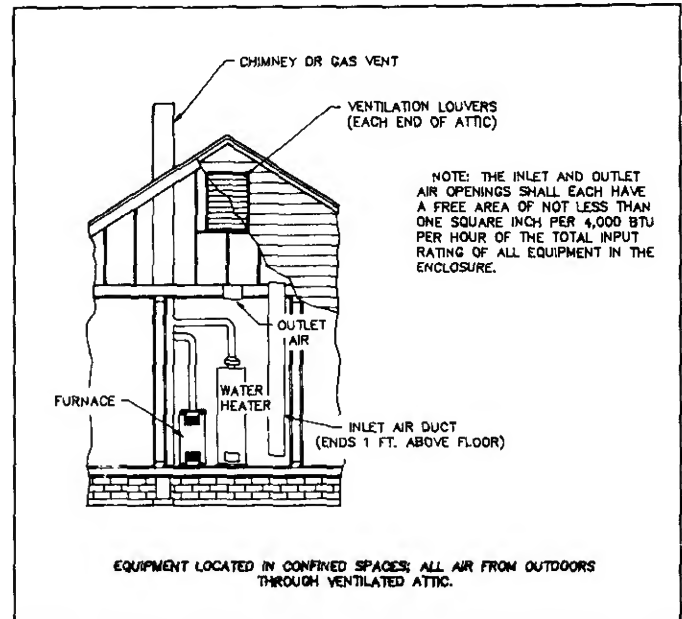


FIGURE 13A

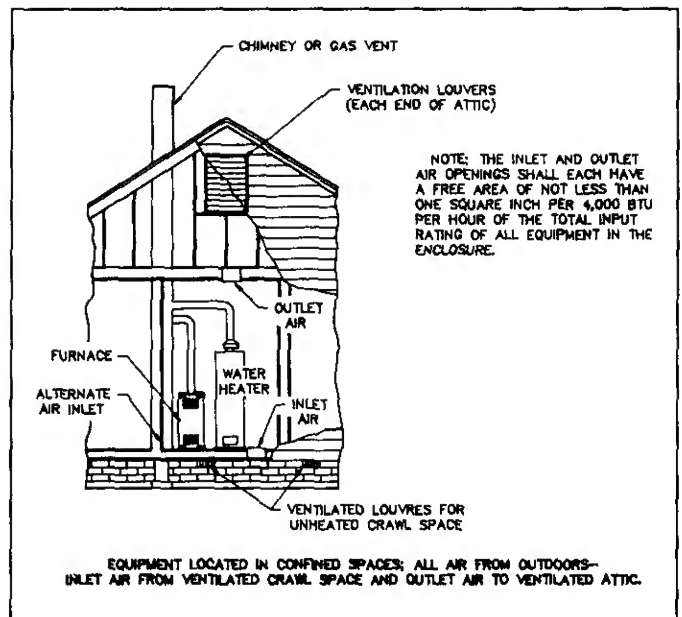


FIGURE 13B

For example:

Total Input Btuh	Required Free Area per Opening (square inches)	Suggested Round Pipe (inches dia.)
40,000	10.0	4
60,000	15.0	5
80,000	20.0	6
100,000	25.0	6
120,000	30.0	7
140,000	35.0	7

5. If combustion air ducts will run horizontally, ducts and each opening must have a minimum free area of one square inch per 2,000 Btuh total combined input rating. You must allow for all gas appliances within the furnace space. See Figure 14.

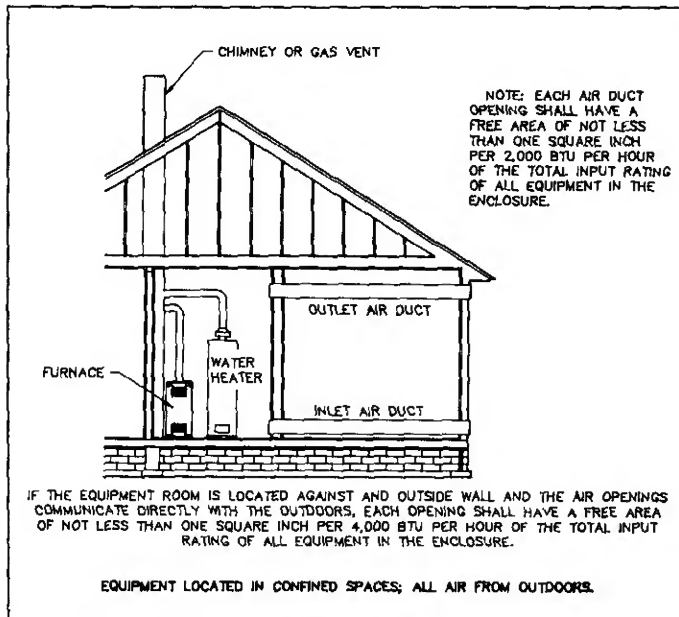


FIGURE 14

For example:

Total Input Btuh	Free Area per Opening (square inches)	Round Pipe (inches dia.)
40,000	20	6
60,000	30	7
80,000	40	8
100,000	50	8
120,000	60	9
140,000	70	10

6. Ducts which introduce combustion and ventilation air from outside structure into furnace space, must have the same cross sectional area as the free area of openings to which they connect. The minimum dimension of rectangular air ducts shall not be less than 3 inches.

## 2. Louvers, grilles, and screens.

Sometimes, louvers, grilles, or screens cover combustion and ventilation air openings. If so, you must provide larger openings than those calculated above. This is necessary because louvers, grilles and screens block and reduce an opening's free area.

Louver, grille and screen manufacturers supply technical data on their products, which usually includes the "free area." Sizing the openings with louvers, grille or screen in place will provide minimum free area to furnace space as calculated above. Do not use screen smaller than 1/4" mesh. If you do not know free area, assume that wood louvers have 20

to 25% free area. Assume metal louvers and grilles have 60 to 75% free area. Refer to current National Fuel Gas Code ANSI Z223.1/NFPA 54.

Example: Furnace is 100,000 Btuh input and is to be installed in a confined space that contains no other gas appliances. Rectangular combustion and ventilation air ducts will run horizontally from outdoors to furnace space.

- a. Calculate free area required.

Because combustion and ventilation air ducts run horizontally, allow 2,000 Btuh. See 2b. above.

$$\begin{array}{rcl} \text{Furnace Input} & & \\ \text{Btuh} & & \\ \hline 2,000 \text{ Btuh} & = & \text{Free Area Required} \\ \text{per square inch} & & \\ \\ 100,000 & & \\ \hline 2,000 & = & 50 \text{ square inches} \end{array}$$

Each opening must have a free area of 50 square inches.

- b. Calculate overall area of openings to give needed free area once you cover them to keep out rain and other outside elements.

Example: If you will use wood louvers to cover combustion and ventilation air openings and you do not know free area of wood louvers, use 20%, as suggested in ANSI Z223.1/NFPA 54.

$$\begin{array}{rcl} 100 \times \text{Free area} & & \\ \text{from a) above)} & = & \text{overall area of} \\ \text{Louver free area} & & \text{openings with wood} \\ \text{openings expressed} & & \text{louvers installed} \\ \text{as a percentage} & & \end{array}$$

$$\begin{array}{rcl} 100 \times 50 & & \\ \hline 20 & = & 250 \text{ square inches} \end{array}$$

Each of the two combustion and ventilation air openings must have a total area of 250 square inches. This is when wood louvers cover openings for a 100,000 Btuh input furnace and combustion and ventilation air ducts run horizontally.

- c. Calculate minimum rectangular duct size needed.

If you choose a rectangular duct with the minimum allowed dimension of 3", the other duct dimension must be at least 16-2/3". This is calculated by dividing the 50 square inches of free area from a) by 3", with equals 16-2/3".

**WARNING:** You must fix combustion and ventilation air louvers and grilles in open position or interlock them with furnace operation. Furnace operation

with louvers or grilles closed could cause inadequate combustion or ventilation air, resulting in injury or death.

#### C. Installing furnace in unconfined space.

Refer to current National Fuel Gas Code ANSI Z223.1/ NFPA 54 for more information. This code does not require that you make special provisions for combustion and ventilation when furnace is in an unconfined space. However, it is always prudent to arrange for combustion and ventilation air as if installation space is confined space.

In the past, infiltration through loose construction provided enough air for combustion and ventilation when furnace was in an unconfined space. Current construction methods may now prevent infiltration of air into unconfined space. These current methods include increased insulation, vapor barriers, tight fitting doors and windows, and weather-stripping.

#### D. Allowing for exhaust fan operation.

1. When furnace is in a ventilated attic, crawl space, residence garage, or outside the heated space, exhaust fan drafts can adversely affect its operation. These drafts can come from kitchens, bathrooms, clothes dryers or anywhere within the heated space.

**WARNING:** Exhaust fans that blow against furnace could cause heat exchanger failure or fire, resulting in damage, injury, or death.

2. When furnace is in a repair garage or inside the heated space, exhaust fans can adversely affect its operation. Exhaust fans in kitchens, bathrooms, clothes dryers or anywhere within heated space increase combustion and ventilation air requirements. This is because exhaust fans reduce the amount of combustion and ventilation air available to the furnace. A fireplace also reduces amount of combustion and ventilation air. You must allow for these reductions.

**WARNING:** You must allow for reduction of air available for combustion and ventilation by exhaust fans and fireplaces. Failure to do so could result in inadequate combustion and ventilation air. This could cause nausea, asphyxiation, or fire, resulting in damage, injury, or death.

3. Exhaust fan air may contain compounds of chlorine, fluorine, bromine, and iodine. If used for combustion, this contaminated air will adversely affect furnace operation.

**WARNING:** If used for combustion and ventilation, contaminated exhaust fan air could cause heat exchanger or vent system failure resulting in damage, injury, or death.

## SECTION 9 — PROVIDING FOR PROPER VENTING.

Vent furnace using these instructions and Venting Addendum. Also, meet requirements of local utilities and other local code authorities. You must connect furnace to a vent or factory-built chimney or a suitably sized, constructed and lined masonry chimney. Vent or factory-built chimney must meet a recognized standard. Chimney lining method and material must comply with local requirements. Use corrosion-resistant material meeting nationally recognized standards for vent construction.

**WARNING:** Inadequate vent or chimney could allow combustion products to collect in structure, resulting in injury or death.

**WARNING:** Vent this furnace separately from any appliance designed to burn solid fuel, particularly wood-burning or coal burning appliances. Improper venting could allow combustion products to collect in structure, resulting in injury or death.

#### A. Venting category.

The furnaces covered by this manual are design-certified as CATEGORY 1 for venting. CATEGORY 1 furnaces have non-positive vent static pressure and rely on the heat content of combustion products to vent. You may common vent CATEGORY 1 furnaces.

The furnaces covered in this manual are also design-certified as CATEGORY 3 for venting, only when they are installed with manufacturer specified vent system components and installation practices.

Category 3 gas appliances rely on the heat content of combustion products and mechanical or other means to vent. You may not common vent CATEGORY 3 gas appliances.

#### B. Types of vent systems.

These definitions will help you understand the terms we use.

1. "Vent" and "chimney" refer to open passageways. These passageways convey vent gases from vent connectors to the outside. Gases begin their final ascent at the vent or chimney. Vents and chimneys usually run vertically or nearly vertical. When they serve only one gas appliance, they are called "dedicated" vents or chimneys. When they serve multiple gas appliances, they are called "common" vents or chimneys.
2. A "vent connector" connects a gas appliance to a vent or chimney. Vent connectors usually run directly from the furnace draft inducer collar to vent or chimney. Vent connectors may have vertical and horizontal runs.
3. A "venting system" is a continuous open passageway from the draft inducer collar to the outside. Venting systems usually have vent connector(s) and a vent or chimney. Venting systems commonly serve a single furnace or a single furnace and a water heater. Other multiple-appliance venting systems are less common.

## C. Design considerations.

### 1. General considerations.

Avoid oversizing furnace for your application. Select a furnace model with a rated heating output close to the calculated heating load. This extends the firing period, decreasing the potential for condensate formation in the vent.

- a. Too small a vent cannot carry all combustion products outdoors. Too large a vent will not vent combustion products rapidly enough to avoid potential for condensation. Refer to Venting Addendum for correct size vent.
- b. Vent height must be a minimum of five feet. Minimize vent connector horizontal runs to the extent possible for best performance.
- c. The designer must consider the building's orientation, answering these questions. Will the vent terminate outside the building where its operation could be adversely affected by winds? Could any adjacent buildings adversely affect vent operation? Allowing for these factors can reduce the possibility of downdraft conditions.
- d. If your local experience indicates possible condensation problems, provide for draining and disposal of venting system condensate.

### 2. Vent sizing.

- a. Sometimes the horizontal distance from the furnace to the vent or chimney is already given; this is known as the horizontal vent connector run. The vent or chimney height is also usually given as is the Btuh input of the gas appliances served by the vent.

Check these parameters to be sure the venting system will work. Use approved engineering practices, Venting Addendum, these instructions, and Part 7 of current National Fuel Gas Code ANSI Z223.1/NFPA 54. Use vent capacity tables in Venting Addendum to check existing or new vent sizes for CATEGORY 1 furnaces.

- b. See Venting Addendum for single appliance venting and multiple appliance (common) venting. For multi-story installations, refer to current National Fuel Gas Code ANSI Z223.1/NFPA 54.
- c. Minimum vent connector diameter from furnace to vent or chimney is same as draft inducer collar.

### 3. Vent connector.

- a. Vent connectors must be made of noncombustible, corrosion resistant material capable of withstanding vent gas temperatures. They must be thick enough to withstand physical damage and be accessible for inspection, cleaning and replacement.

- b. Use Type B1 vent connectors in or through attics, crawl spaces, or other cold areas. Install thimbles that meet local codes when vent connectors pass through walls or partitions of combustible material.

- c. Keep vent connectors as short as possible by locating furnace as close as practical to vent or chimney. Avoid unnecessary turns or bends which create resistance to flow of vent gases.

*Adding an elbow adds resistance. For example, adding a 6" 90-degree elbow would be the equivalent of adding 20 feet of horizontal 6" pipe. 45-degree elbows have lower resistance than 90-degree elbows, and can work for most vent runs.*

- d. You may increase vent connector diameter to overcome installation limitations and obtain connector capacity equal to furnace input. Make this increase as close as possible to draft inducer collar, allowing for necessary adapters and fittings.

- e. If you join two or more vent connectors before they enter the vertical vent or chimney, use caution. See Venting Addendum.

- f. Do not connect this furnace to any portion of a vent system which operates under positive pressure. Positive pressure would result with CATEGORY 3 and 4 appliances connected to the vent.

- g. Do not connect vent connector to a chimney flue serving a fireplace unless you permanently seal fireplace flue opening.

### 4. Vertical vent or chimney.

- a. Vents and chimneys usually extend vertically with offsets not exceeding 45-degrees. Consider vent pipe runs more than 45-degrees as horizontal runs. Include their length in the total horizontal run.

- b. Designer and installer must provide an appropriately sized common vent for all appliances connected to it. See Venting Addendum.

- c. Connect this CATEGORY 1 furnace only to vent systems with other CATEGORY 1 appliances.

**WARNING:** Do not connect this Category 1 furnace to a vent system used by Category 3 and 4 appliances. Do not connect it to vents with mechanical draft systems operating at positive pressure. Improper venting could allow combustion products to collect in structure during use, resulting in damage, injury or death.

### 5. Chimney.

Furnace is suitable for venting into a properly sized and lined masonry chimney. Consult National Fuel Gas Code ANSI Z223.1/NFPA 54 for construction details. If chimney is oversized, liner is inadequate

or evidence of condensate exists, consider using chimney as a pathway for suitably sized Type B1 vent liner. See Figure 15.

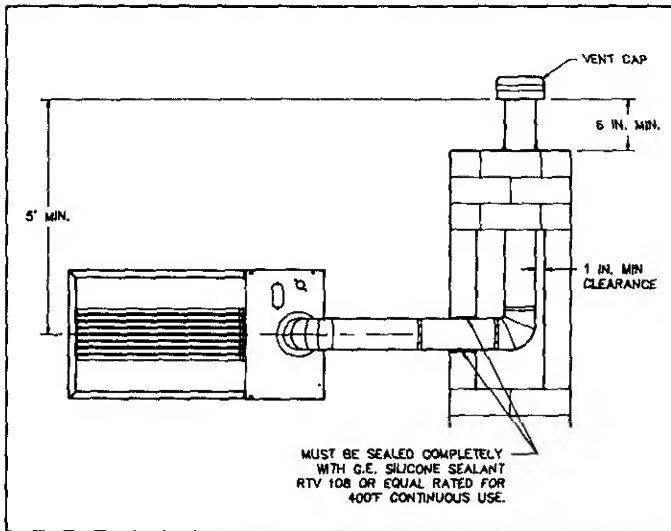


FIGURE 15

**WARNING:** Support Type B1 vent liner in masonry chimney. Maintain at least a 1" clearance on all sides to reduce possibility of condensate in vent. Condensate may cause vent to deteriorate allowing combustion products to collect in structure, which could result in injury or death. See Figure 16.

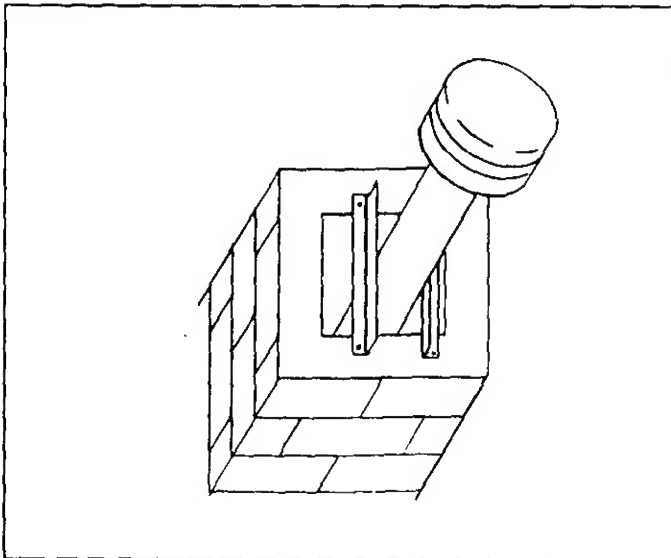


FIGURE 16

**WARNING:** Vent liner must not block opening where other appliances' vent connectors enter chimney. Blocked openings could cause combustion products to collect in structure, resulting in damage, injury or death.

**WARNING:** Do not use unlined masonry chimneys. These increase risk of condensate formation, which may cause chimney to deteriorate, allowing combustion products to collect in structure, resulting in damage, injury or death.

**NOTE:** For more information on proper chimney inspection and relining procedures, Gas Research Institute (GRI) has a topical report entitled "Masonry Chimney Inspection and Relining". Obtain copies through American Gas Association (A.G.A.) at 1- 800-841-8400.

#### 6. Vent termination.

- a. Terminate all vertical vents with a listed vent cap or roof assembly unless local codes require otherwise. See vent cap or roof assembly manufacturer's instructions. Locate vent termination (vent cap or roof assembly) in an area without positive wind pressures or eddy currents. Eddy currents occur when air swirls over roof peaks. They can cause down-drafts and adversely affect vent operation. See Figure 17.

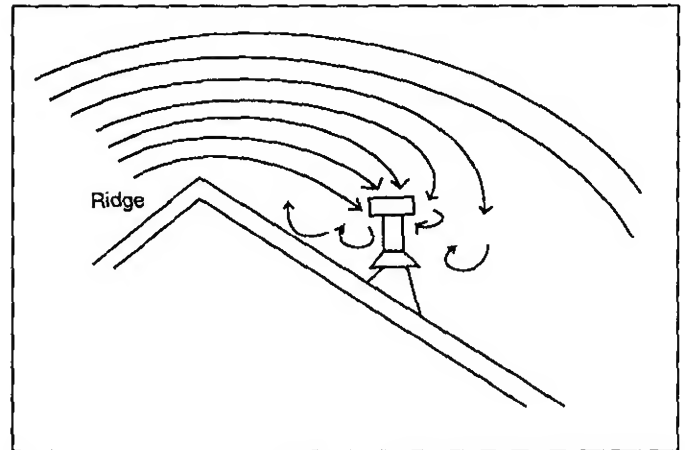
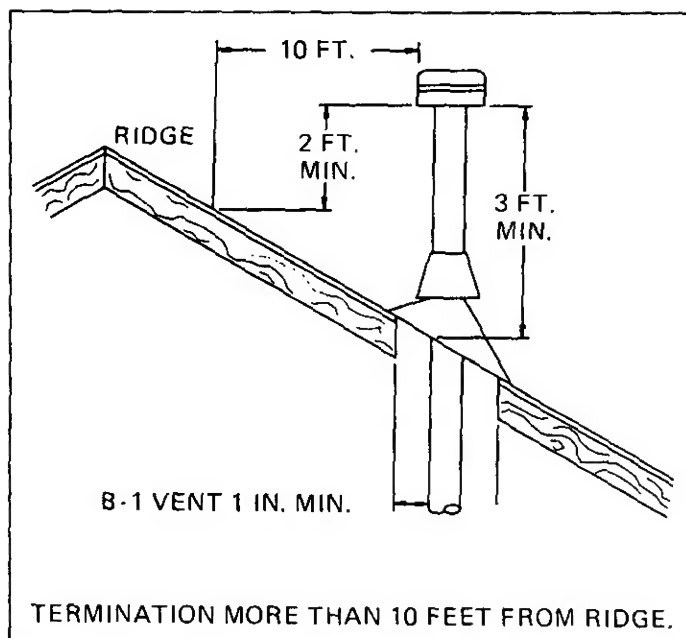


FIGURE 17

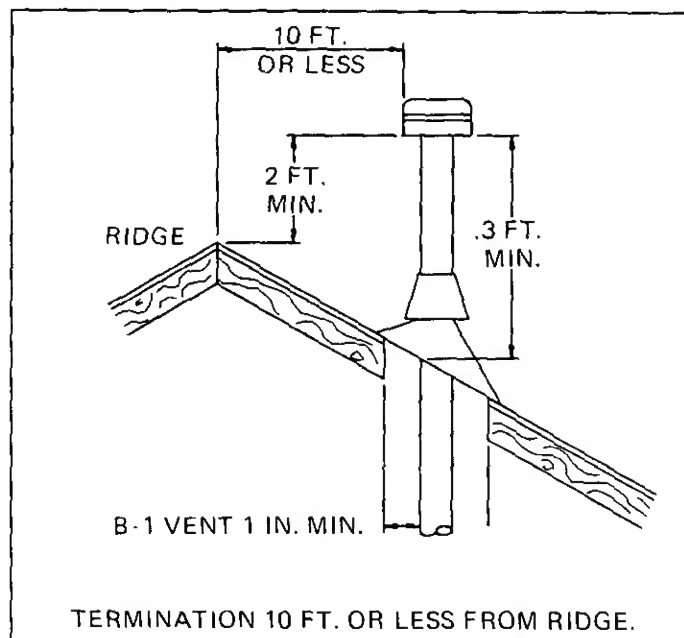
Some vent terminations or caps protect against eddy currents and down-drafts. Consult their manufacturer's instructions. Vent terminations or caps should usually be at least the same size as the vent. They may be larger if the installation warrants.

- b. Vent systems must end at least five feet above the highest gas appliance connection. Vent pipe must extend at least three feet above the point where it passes through the roof. Vent termination must be at least two feet higher than any portion of building within ten feet horizontal and vent termination must be at least two feet higher than roof peaks within ten feet horizontal. See Figures 18 and 19. Some vent cap manufacturers offer vent caps that allow reduced clearances. Consult their instructions.





**TERMINATION MORE THAN 10 FEET FROM RIDGE  
FIGURE 18**



**TERMINATION 10 FEET OR LESS FROM RIDGE  
FIGURE 19**

**WARNING:** Failure to properly terminate vent chimney systems could allow combustion products to collect in structure, resulting in injury or death.

- c. Terminate venting system at least three feet above any forced-air building inlet within ten feet. Consider doors, windows and gravity air building inlets. Locate vent termination at least four feet below, four horizontal feet from or one foot above any of these openings.

## D. Installation.

### 1. Vent connectors.

Attach vent connector at draft inducer collar. Make sure flue gasket is in place providing a seal. Use a minimum of three equally spaced screws around connection. Connect all other vent pipes using three equally spaced screws at each joint. Exception is only when you use Type B1 vent pipe with self-locking connections or high temperature plastic pipe.

**WARNING:** Unsecured vent pipe connections may loosen. This can allow combustion products to collect in structure, resulting in injury or death.

Install vent connectors without any dips or sags. Slope them upward from furnace at least 1/4" per foot. To prevent sagging, at each joint support vent connectors and horizontal portions using hinges, straps or equivalent. Seal all connections where vent connectors enter chimney. See Figure 15.

To avoid blockage, attach vent connector to a masonry chimney above the extreme bottom. For inspection ease, use thimble or slip joint to make vent connector removal easy. Firmly attach connector. Insert all vent connectors into, but not beyond, inside chimney wall.

### 2. Vertical vent or chimney systems.

Install vent materials following their listing terms, manufacturer's instructions, these instructions and local codes.

A gas vent passing through a roof must extend through roof flashing, jack or thimble. It must terminate above roof surface.

## E. Existing vent considerations.

Masonry chimneys previously used for venting solid fuel or oil burning equipment should be lined with suitable metal liner. Also provide an accessible clean out per current National Fuel Gas Code ANSI Z223.1/NFPA 54.1.

### 1. Inspection of vents (chimneys).

- a. Make sure existing vent or chimney is proper size and construction for appliances that will use it. The best way to do this is to size as if it were a new installation. Compare the existing vent to your calculations and make necessary corrections.
- b. Examine vent or chimney cleanouts to make sure they remain tightly closed when not in use. Make sure vent or chimney passageway is clear and free of obstructions. Look for evidence of condensate or deterioration in vent or chimney. Either of these means an inadequate vent.
- c. If you find an inadequate vent or chimney, do not leave it as is. Repair or replace it. A new vent must meet these instructions and current



National Fuel Gas Code ANSI Z223.1/NFPA 54.  
Rebuild a chimney to meet national standards.

**WARNING:** An inadequate vent or chimney could allow combustion products to collect in structure, resulting in injury or death.

- d. Sometimes you will replace a common vented appliance. Make sure common vent size is correct for all appliances connected to it. If you remove a furnace from a common vent without replacing it, the vent will likely be too large for remaining appliances. See Venting Addendum.
- e. The following steps shall be followed with each appliance remaining connected to common venting system placed in operation, while other appliances remaining connected to common venting system are not in operation.
  1. Seal any unused openings in common venting system.
  2. Visually inspect venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
  3. Insofar as is practical, close all building doors and windows and all doors between space in which appliances remaining connected to common venting systems are located and other spaces of building. Turn on clothes dryers and any appliances not connected to common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
  4. Follow Operating Instructions. Place appliance being inspected in operation. Adjust thermostat so appliance will operate continuously.
  5. After it has been determined that each appliance remaining connected to common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous conditions of use.
  6. If improper venting is observed during any of the above tests, common venting systems must be corrected.

**NOTE:** Follow current National Fuel Gas Code ANSI Z223.1/NFPA 54 to correct improper common vent operation. Any common vent resizing must approach minimum size determined by using Venting Addendum.

## SECTION 10 — TOOLS NEEDED FOR INSTALLATION.

ITEM	TOOL DESCRIPTION	USED FOR
<b>A. HAND TOOLS</b>		
1.	Carton Knife	Furnace removal from carton
2.	1/4" nut driver	Control box cover
3.	5/16" nut driver	Casing and blower
4.	3/8" nut driver	Blower and motor mounts
5.	1/4" x 8" straight-blade screwdriver	Wire terminals and manifold pressure adjustment
6.	#2 x 8" Phillips screwdriver	Components in control box
7.	7/16" open end or tubing wrench	Main burner orifices
8.	2-8" to 14" pipe wrenches	Gas pipe installation
9.	4" adjustable wrench	Blower wheel set screw tightening
10.	8" Channel-lock pliers	Strain reliefs
11.	3/16" Allen wrench	Inlet and outlet pressure tap plug removal from gas control
12.	9/64" Allen wrench	Honeywell gas inlet fitting
<b>B. SUPPLIES</b>		
13.	Pipe thread sealant suitable for use with propane (LP) gas	Gas pipe and controls
14.	Bottle of soap solution	Gas leak checking
15.	2-1/8" pipe, manual shutoff valves	Gas control inlet and pressure checking
<b>C. TEST INSTRUMENTS</b>		
16.	Volt meter with 50 and 150 volt ranges	Electrical check of controls and power supply
17.	Clamp around ammeter with 10 amp and higher ranges	Amp draw of motors and control check

18.	10-turn coil of wire to fit on ammeter	Room thermostat heat anticipator setting
19.	"U" Tube Water Manometer with 0.1" resolution 0" to 15" W.C. range	Gas pressure measurement
20.	Slope gauge with 0.01" pressure measurement taps and tubing, 0 to 1" W.C. range	Duct work static pressure
21.	2 thermometers with 1-degree Fahrenheit resolution, 50 degrees F to 175 degrees F range	Temperature rise measured through furnace
22.	Stop watch	Gas input meter timing
23.	Torque wrench (100 inch-pounds)	Proper screw installation

## SECTION 11 — INSTALLING GAS PIPING.

Equipment needed: Save time by getting these tools before you start: Item number(s) 8,12,13 and 14 listed in Section 10.

### A. Preparation.

Gas piping must meet requirements of current National Fuel Gas Code ANSI Z223.1/NFPA 54 and local codes. Size of pipe running to furnace depends on:

- Length of pipe;
- Number of fittings;
- Specific gravity of gas;
- Input requirements (Btuh) of all gas-fired appliances attached to same main supply line.

Refer to current National Fuel Gas Code ANSI Z223.1/NFPA 54 for correct gas pipe sizing information.

Plan furnace gas supply piping so it will not interfere with removal of burner assembly, front door or blower door for servicing.

Always use a pipe thread sealant which is resistant to propane (LP) gas solvent action. Sparingly apply sealant to all joints on male threads only, starting two threads back from end.

### B. Installation.

1. Install A.G.A. listed manual shut-off valve in gas supply line immediately upstream of furnace. Install 1/8" NPT plugged tapping accessible for test gauge connection. Omit separate, plugged tapping if local area accepts plugged tapping in gas control inlet.
2. After in-line manual shut-off valve, install a drip leg (sediment trap) at gas supply line inlet connection to

furnace. A convenient way to do this when you have reduced bottom clearance, is to make drip leg by using a 1/2" to 1" NPT Tee. Then install a 1-1/2" long, 1" NPT nipple in Tee with a 1" NPT pipe cap to complete drip leg.

3. When using black iron gas pipe, install an A.G.A. listed ground joint union between drip leg (sediment trap) and furnace gas control. Locate ground joint union to allow easy servicing of burner assembly and gas control.
4. Install gas pipe to inlet side of furnace gas control.

**WARNING:** Do not thread gas pipe too far. Doing so may cause gas control to split or crack which could cause a gas leak or distortion or malfunction of gas control. These could cause a fire or explosion resulting in damage, injury or death.

5. Isolate gas control from gas supply line pressure during leak check. Gas supply line test pressure determines how you isolate gas control.

**WARNING:** At gas supply line, test pressure equal to or less than 14 inches W.C. (1/2 PSI). Isolate gas control from gas supply line by turning furnace gas control knob clockwise > to off position. Unexpected surges could damage gas control causing gas to leak, resulting in fire or explosion.

**WARNING:** When test pressure is above 14 inches W.C. (1/2 PSI), completely disconnect gas control from gas supply line. Failure to isolate gas control from test pressure could damage it, causing gas to leak, resulting in fire or explosion.

6. Use a commercial soap solution made to detect leaks and check all gas piping connections. Bubbles indicate gas leakage. Seal all leaks before proceeding.

**WARNING:** Never use an open flame to check for gas leaks. If a leak does exist, a fire or explosion could occur, resulting in damage, injury or death.

### C. Furnace Gas Entry Piping.

1. See below for gas entry holes and knockouts.
  - a. A 1-1/4" x 2-3/4" knockout in top plate.
  - b. A 1-1/2" diameter hole and a 1-1/4" x 1-15/16" knockout in right side of casing.
  - c. Two 1-5/8" diameter knockouts in left side of casing.

### 2. Changing Gas Control Inlet.

You may want to change direction of gas inlet elbow on gas control. Gas control is shipped for right side gas entry. If you need top entry, remove the fitting. If you need left side gas entry, rotate the fitting 180 degrees.

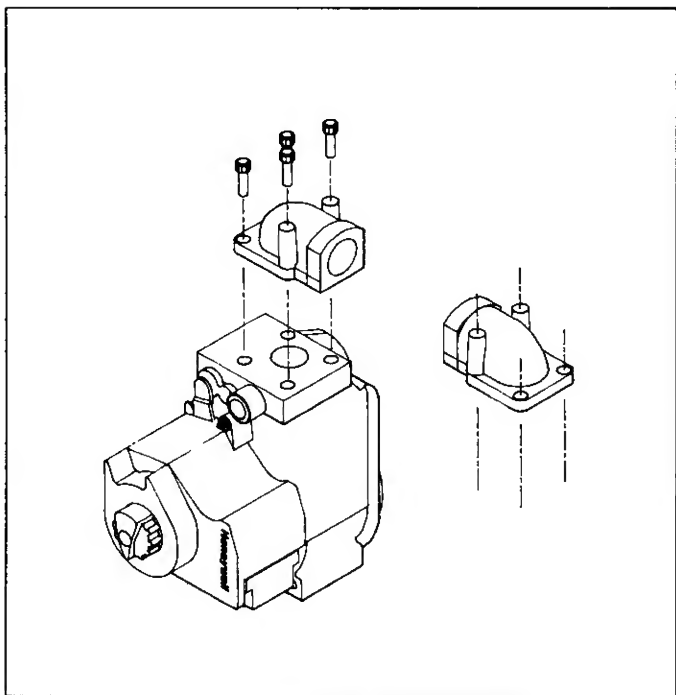


FIGURE 20

- a. Use 9/64" Hex Allen wrench to remove four screws. Check that O-ring is in bottom of gas inlet elbow. Rotate elbow to desired position.
- b. Alternately tighten four screws to 45 inch pounds to form a gas tight seal.
- c. Use a commercial soap solution made to detect leaks and check all gas piping connections. Bubbles indicate gas leakage. Seal all leaks before proceeding.

**WARNING:** Never use an open flame to check for gas leaks. If a leak does exist, a fire or explosion could occur, resulting in damage, injury or death.

### 3. Allowing for Electronic Air Cleaners.

Some large electronic air cleaners will interfere with incoming gas line. Install air cleaner on opposite furnace side from gas entry or route gas pipe over top of air cleaner through one of alternate knockouts.

## SECTION 12 — INSTALLING ELECTRICAL WIRING.

**Equipment Needed:** Save time by getting these tools before you start: Item number(s) 2 listed in Section 10.

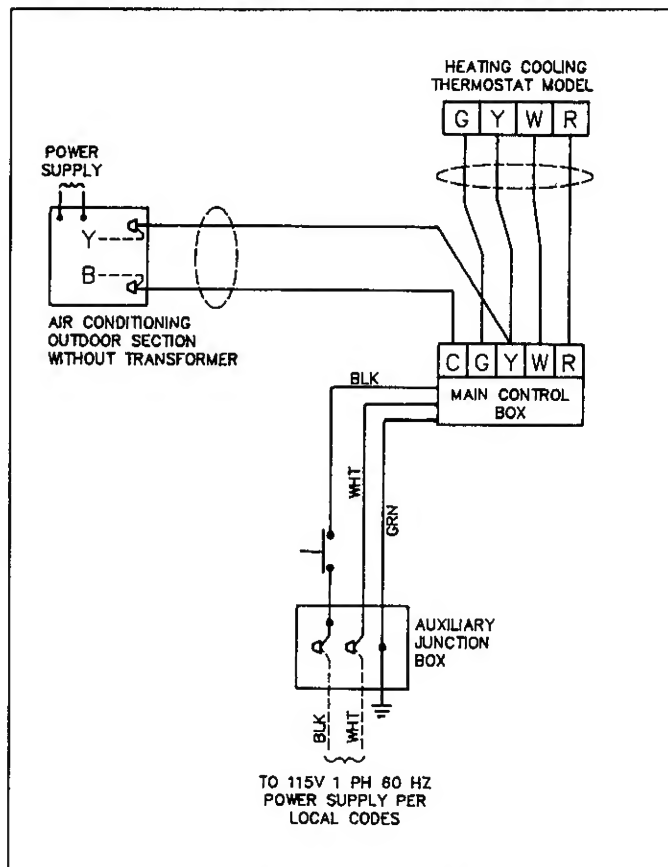
Select a location for room thermostat that is away from supply and return air registers, on draft-free interior wall, and not near lights, television, direct sunlight, or other heat sources. Install thermostat following field wiring diagram in Section 13. Use electrical wiring that meets current National Electrical Code ANSI/NFPA 70 and local codes. Use Type T (63 degrees C rise) wire or equivalent. See Section 30 for code information.

**WARNING:** Provide furnace with its own separate electrical circuit, means of circuit protection and electrical disconnect switch. Follow current National Electrical Code ANSI/NFPA 70 and state and local codes. Failure to provide these shut-off means could cause electrical shock or fire, resulting in damage, injury or death.

Install proper electrical grounding by attaching grounding source to green wire conductor in furnace junction box. Follow current National Electrical Code ANSI/NFPA 70 and local codes.

**WARNING:** Furnace must have proper electrical ground. Failure to provide a proper electrical ground could cause electrical shock or fire, resulting in damage, injury or death.

## SECTION 13 — FOLLOWING FIELD WIRING DIAGRAM



FIELD WIRING DIAGRAM  
FIGURE 21

**NOTE:** When replacing original wire, use same type, color, or equivalent wire. Remember to renumber wire ends.

## SECTION 14 — ADJUSTING ROOM THERMOSTAT HEAT ANTICIPATOR

**Equipment Needed:** Save time by getting these tools before you start: Item number(s) 5, 17 and 18 listed in Section 10.

Wire system using field wiring diagram in Section 13.

## A. Exact heat anticipator setting.

Exactly setting heat anticipator helps avoid potential callbacks. If you have any of the following factors, set heat anticipator to match actual current draw in circuit.

- The system contains controls other than those specified on wiring diagram;
- The system contains nonstandard (18 AWG) size thermostat wire;
- The system has longer than a 30-foot distance between thermostat and furnace.

Follow these steps to exactly set heat anticipator:

1. Use 2-foot piece of 24-gauge thermostat wire, stripped on both ends.
2. Use ammeter capable of reading exact amperage in 0-10 amp range. If it is adjustable, set on 0-10 scale.
3. Wind the 2-foot piece of 24-gauge thermostat wire ten times around one open arm of ammeter. Close ammeter arms. This will act as a ten times multiplier.
4. Make sure 115-volt power to furnace is on. Connect ends of wire on ammeter across terminals "R" and "W" of thermostat sub-base. Follow Figure 22.

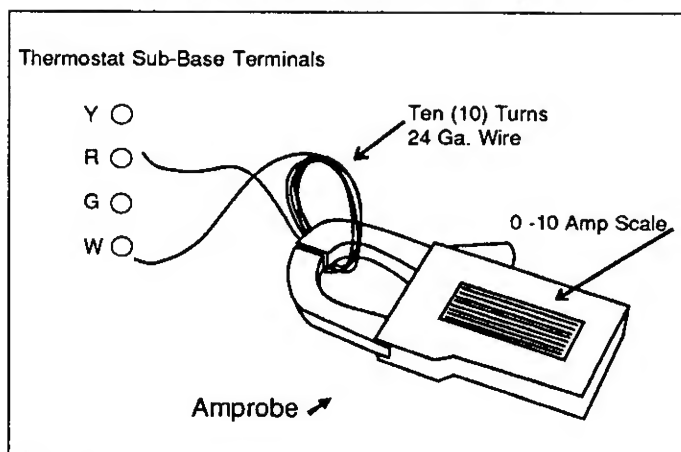


FIGURE 22

5. Read amp draw of furnace circuit on ammeter and divide by 10. This gives you an exact heat anticipator setting.

Example:

Meter reading	=	9 amps
Divide by 10 turns	=	10
Heat anticipator setting	=	.9 amps

6. Set room thermostat's heat anticipator to this amp setting. Follow instructions provided with thermostat.

## B. Approximate heat anticipator setting.

Find heat anticipator under room thermostat cover. Set heat anticipator at 0.6 amps. Follow instructions provided with thermostat.

## SECTION 15 — SEQUENCE OF OPERATION.

See Figure 23 for furnace wiring diagram.

Thermostat calls for heat, energizing electronic ignition lock-out module. Electronic ignition lockout module provides power to gas control and igniter to light pilot. After proving pilot flame, inducer relay (IDR) closes, energizing inducer motor. Inducer motor starts and pressure switch closes, energizing gas control and time delay relay (TDR). Time delay relay energizes main blower within 20 to 30 seconds.

**NOTE:** If system locks out, set room thermostat below room temperature for at least 10 seconds, then return to desired setting. To purge gas lines, it may be necessary to operate furnace through more than one lockout cycle at start-up.

After room thermostat is satisfied, gas control and inducer relay are de-energized simultaneously. Inducer motor de-energizes and returns pressure switch to normally closed (N.C.) position. Main blower remains energized through time delay relay for up to 180 seconds.

## SECTION 16 — INSTALLING DUCT WORK.

**CAUTION:** Install all duct work to meet current standards:

- ASHRAE/NFPA 90, Standard for Installation of Warm Air Heating and Air Systems;
- State and local codes.

**Failure to follow these standards could reduce air flow or increase air leakage, resulting in reduced system performance or furnace damage.**

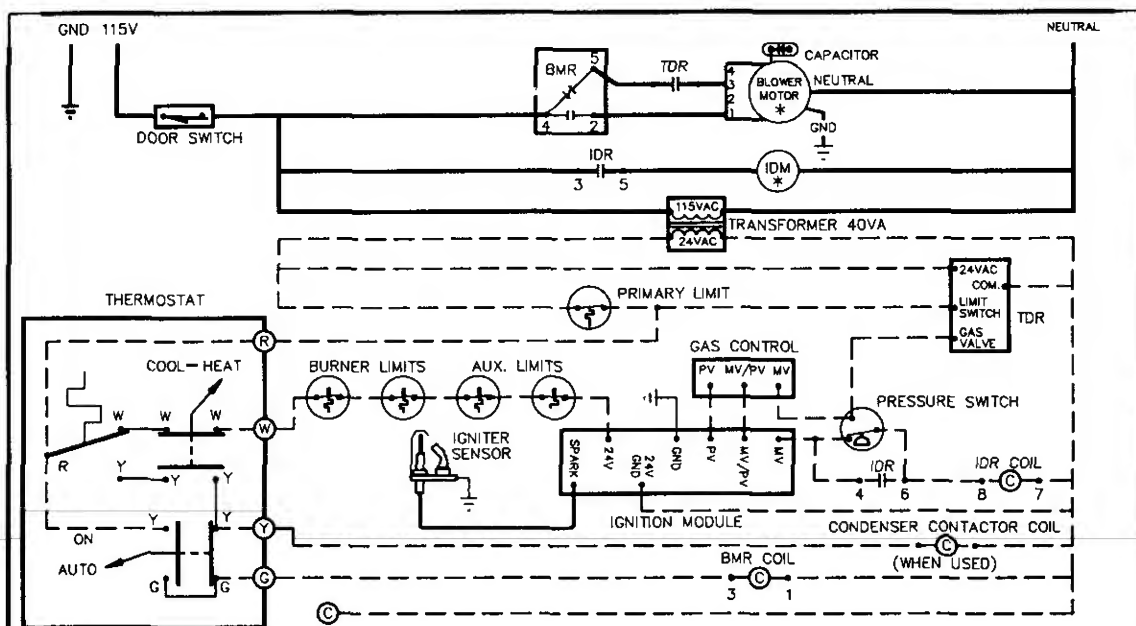
Properly size duct work based on heat loss and heat gain calculations. Doing so assures:

- Good heating and cooling installations;
- Potentially fewer callbacks;
- Delivery of required circulating air.

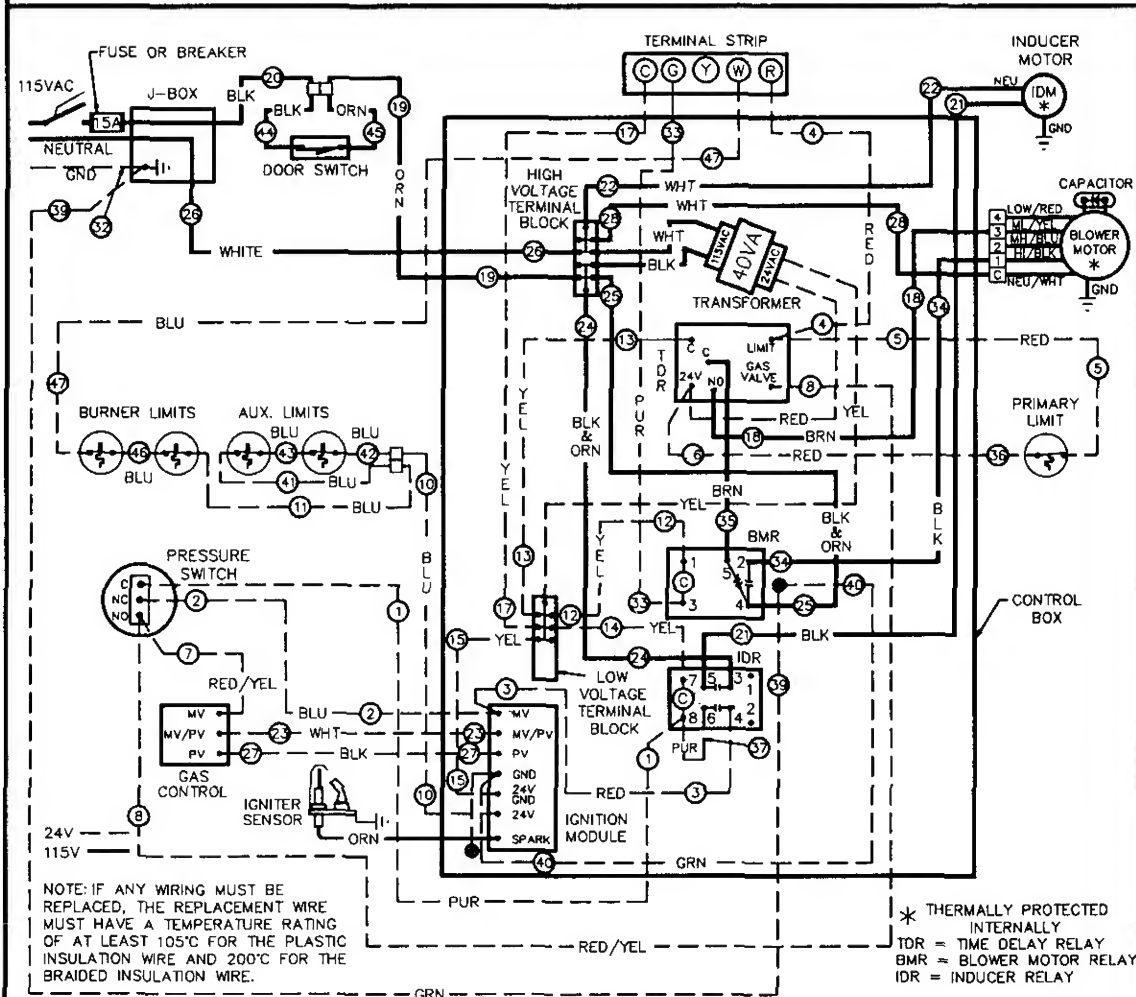
For all furnaces, design duct systems for minimum and maximum external static pressures detailed in Figure 24. See Section 25 on measuring duct work static pressure.

**NOTE:** When furnace is installed in an upflow position, air delivery above 1800 CFM requires both sides of furnace be used for return air, or a combination of one side and bottom or bottom only.

Downflow installations use top return or top and side return. Horizontal installations use end return or end and top return.



NOTE: FURNACE MUST BE GROUNDED AND CONFORM TO LATEST N.E.C. AND LOCAL CODES



NOTE: IF ANY WIRING MUST BE REPLACED, THE REPLACEMENT WIRE MUST HAVE A TEMPERATURE RATING OF AT LEAST 105°C FOR THE PLASTIC INSULATION WIRE AND 200°C FOR THE BRAIDED INSULATION WIRE.

\* THERMALLY PROTECTED INTERNALLY  
TDR = TIME DELAY RELAY  
BMR = BLOWER MOTOR RELAY  
IDR = INDUCER RELAY

910604

HONEYWELL VR8204M-SB600H

405060

FIGURE 23

**EXTERNAL STATIC PRESSURE  
(Inches of Water Column)**

*INPUT (BTU/HR)	MINIMUM	MAXIMUM
40,000	0.10	0.50
60,000	0.12	0.50
80,000	0.12	0.50
100,000	0.15	0.50
120,000	0.20	0.50
140,000	0.20	0.50

\*Input is on furnace rating plate on blower door.

**FIGURE 24**

**A. Supply air duct work.**

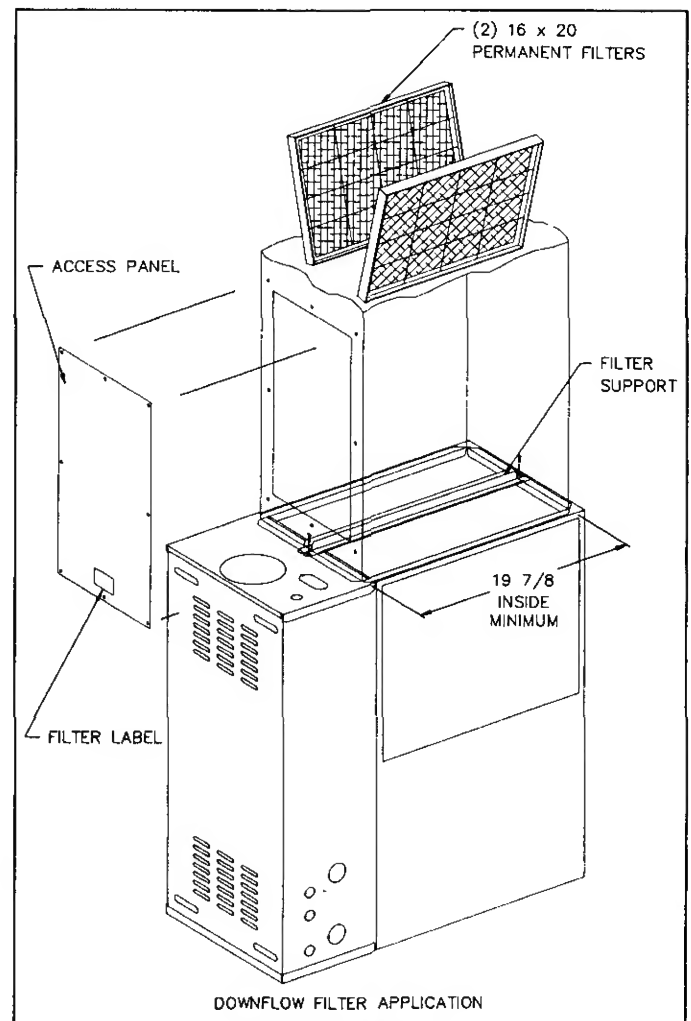
**NOTE:** Supply air duct (plenum) connection must be the same size as the furnace supply air opening. Attach to furnace duct flanges.

If you install furnace in horizontal position with an air conditioner, design a minimum 18" long transition that allows free air flow through furnace and cooling coil. Make sure furnace temperature rise is within range noted on furnace rating plate. Also, consult air conditioner's duct work installation instructions.

Seal supply air duct work to furnace casing, walls, ceilings or floors it passes through. End duct work outside furnace space.

**B. Return air duct work.**

1. In upflow position, return air duct must be a minimum depth of 23-31/32". See Figure 25.
2. In downflow position, return air duct must be a minimum 19-7/8" inside depth. See Figure 26.

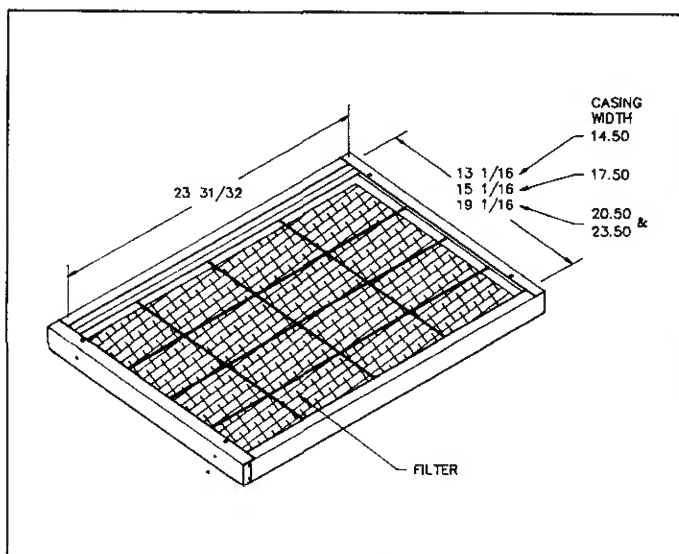


**FIGURE 26**

**NOTE:** In upflow position, if bottom return air is not used, you must attach a solid bottom closure panel to bottom return air opening. Bottom closure panel is available from manufacturer as follows:

BTU/HR* INPUT	MOTOR* H.P.	BOTTOM CLOSURE PART NUMBER
40,000	1/4	4045900
40,000	1/3	
60,000	1/4	
60,000	1/3	
60,000	1/2	4045901
80,000	1/4	4045900
80,000	1/3	
80,000	1/2	4045901
80,000	3/4	4045902
100,000	1/3	4045901
100,000	1/2	
100,000	3/4	4045902
120,000	1/2	
120,000	3/4	
140,000	3/4	4045903
140,000	3/4	

\*See furnace rating plate on blower door.



**FIGURE 25**

**WARNING:** Failure to install bottom closure panel could allow combustion products to enter circulating air stream, resulting in injury or death.

When furnace is installed so that supply air ducts carry air to areas outside the space containing the furnace, return air must also be handled by a duct(s) sealed to furnace casing and terminating outside the space containing furnace.

Avoid vent system reverse pressure by running return air duct work outside furnace space. Seal return air duct work to furnace casing, walls, ceilings or floors it passes through. End duct work outside furnace space.

**WARNING:** Failure to seal return air duct work could allow combustion products to enter circulating air stream through air stream leaks, resulting in injury or death.

#### C. Duct dampers.

You may balance air flow with dampers installed in each branch run duct and adjust for even temperature throughout the heated space. For proper furnace operation, make sure:

- Supply air registers and return air grilles are open;
- Rugs, carpets, drapes or furniture are clear of registers and grilles;
- Size and shape of supply air plenum is correct;
- Number of supply air ducts is correct;
- You consider your own experience and seek assistance if needed.

#### D. Common duct work.

If furnace will share common duct work with a separate cooling unit, install furnace parallel to or upstream of cooling unit. This avoids condensation in heating element. Do not install cooling coil in return air duct work.

With parallel flow, dampers or other means must prevent chilled air from entering furnace. If dampers or other means are not in full heat or cool position, furnace or cooling unit must not operate.

### SECTION 17 — SELECTING AND INSTALLING FILTER CABINETS.

**CAUTION:** You must install air filters to keep these components clean: blower motor, blower wheel and air conditioning coil, if there is one. Dirty equipment may reduce system efficiency or cause erratic control performance, resulting in damage to blower motor or heat exchanger and air conditioner (if installed).

Do not install air filters inside furnace casing.

There are no air filters shipped with this furnace. Obtain and install correct size filters and proper filter frames. Air velocity must not exceed 300-feet per minute through low velocity disposable filters.

Air velocity must not exceed 650-feet per minute through high velocity cleanable filters. Too small a filter could cause

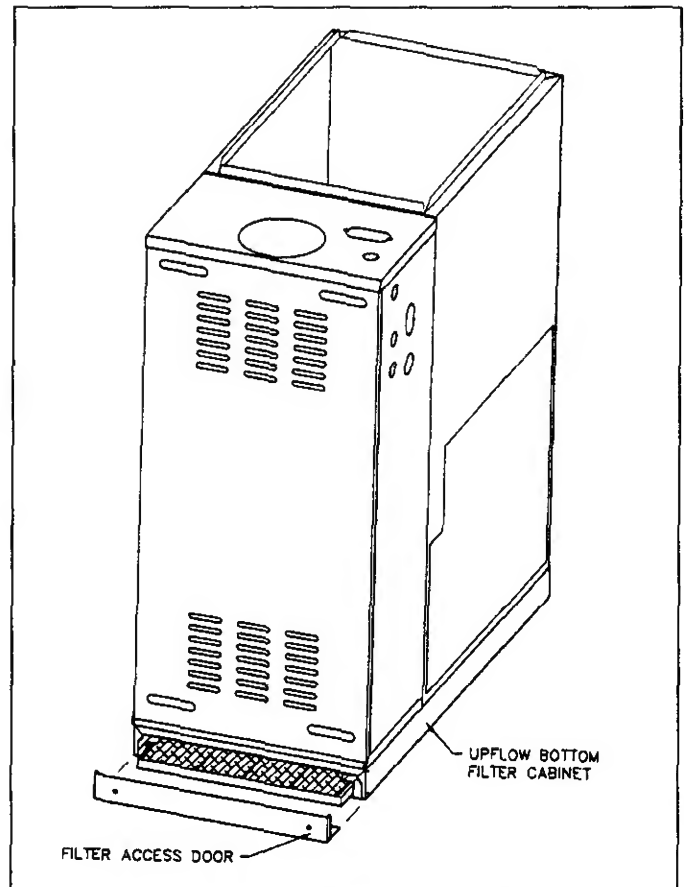
excess static pressure, adversely affecting furnace and cooling system operation.

Follow minimum sizing and quantity recommendations in Figure 27, as well as the air filter manufacturer's.

*GAS INPUT BTU/HR	*MOTOR H.P.	DISPOSABLE AIR FILTERS (FIELD SUPPLIED) (Two Required) SIZE	CLEANABLE AIR FILTERS (FIELD SUPPLIED) (One Required) SIZE
40,000	1/4	14 X 25 X 1	14 X 25 X 1
40,000	1/3	14 X 25 X 1	14 X 25 X 1
60,000	1/4	14 X 25 X 1	14 X 25 X 1
60,000	1/3	14 X 25 X 1	14 X 25 X 1
60,000	1/2	16 X 25 X 1	16 X 25 X 1
80,000	1/4	14 X 25 X 1	14 X 25 X 1
80,000	1/3	14 X 25 X 1	14 X 25 X 1
80,000	1/2	16 X 25 X 1	16 X 25 X 1
80,000	3/4	20 X 25 X 1	20 X 25 X 1
100,000	1/3	16 X 25 X 1	16 X 25 X 1
100,000	1/2	16 X 25 X 1	16 X 25 X 1
100,000	3/4	20 X 25 X 1	20 X 25 X 1
120,000	1/2	20 X 25 X 1	20 X 25 X 1
120,000	3/4	20 X 25 X 1	20 X 25 X 1
140,000	3/4	20 X 25 X 1	20 X 25 X 1
140,000	3/4	20 X 25 X 1	20 X 25 X 1

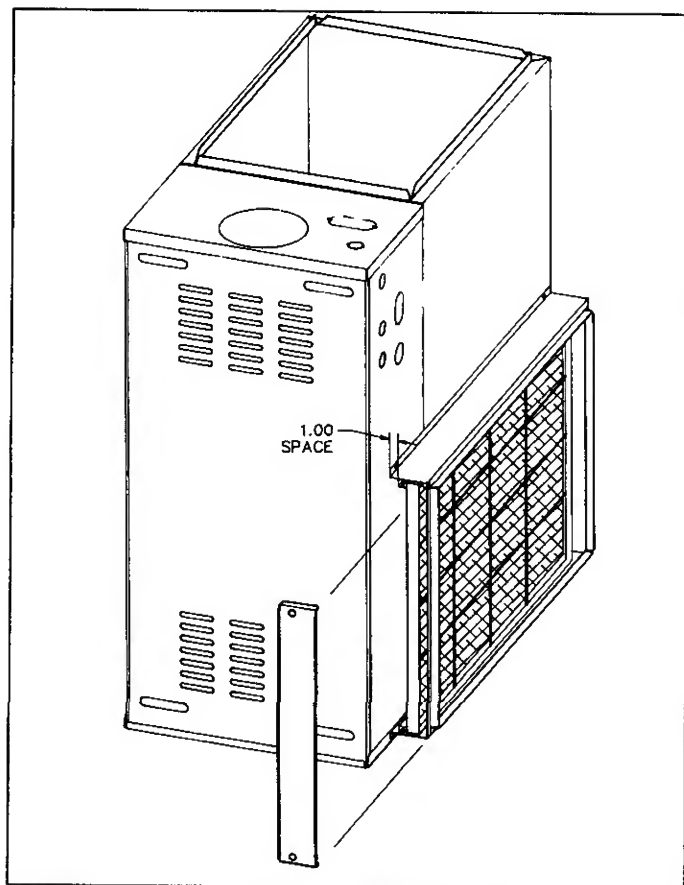
\*GAS INPUT and MOTOR H.P. can be found on furnace rating plate.

FIGURE 27



UPFLOW BOTTOM FILTER CABINET  
FIGURE 28





**UPFLOW SIDE FILTER CABINET  
FIGURE 29**

**1. Upflow Positions.**

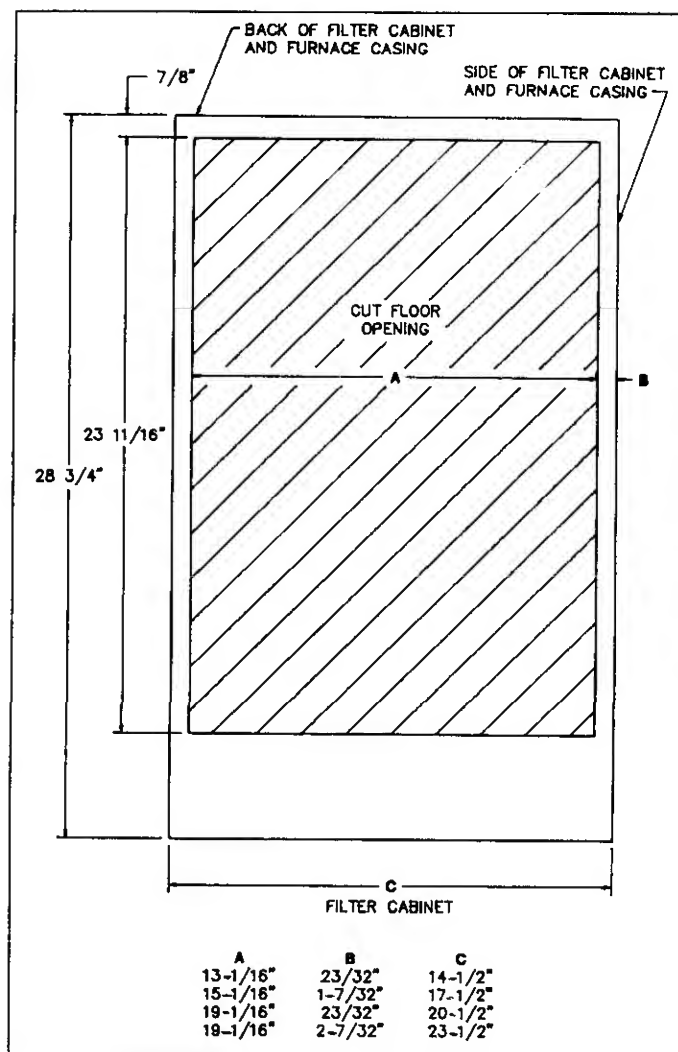
- a. Upflow position uses a bottom filter cabinet, side filter cabinet or return air filter grille (field supplied).

Manufacturer available bottom and side filter cabinets provide correct filter spacing to assure designed airflow. Field fabricated filter cabinets should allow 1" spacing between filter and furnace.

- b. 1. For upflow side return, use a 16x25 filter.
2. For upflow air delivery above 1800 CFM use the following combinations of return air openings:
1. Bottom only or
  2. 1 Side and Bottom or
  3. Both sides.

Use appropriate filter cabinets with combinations listed above.

- c. See figures 30A and 30B for floor cut out and filter size of bottom filter cabinet available from manufacturer.



**UPFLOW FLOOR CUT OUT FOR  
BOTTOM FILTER CABINET  
FIGURE 30A**

Bottom Return Filter Sizes		
GAS INPUT *BTU/HR	MOTOR *H.P.	FILTER SIZE
40,000	1/4	14 x 25
40,000	1/3	14 x 25
60,000	1/4	14 x 25
60,000	1/3	14 x 25
60,000	1/2	16 x 25
80,000	1/4	14 x 25
80,000	1/3	14 x 25
80,000	1/2	16 x 25
80,000	3/4	20 x 25
100,000	1/3	16 x 25
100,000	1/2	16 x 25
100,000	3/4	20 x 25
120,000	1/2	20 x 25
120,000	3/4	20 x 25
140,000	3/4	20 x 25
140,000	3/4	20 x 25

\*See furnace rating plate located on blower door.

**FIGURE 30B**

**NOTE:** Bottom and side filter cabinets available from manufacturer have a 1 inch space between furnace casing and filter for increased filter area. Placing filter (field-supplied) directly against furnace bottom or side will decrease airflow and adversely affect furnace operation. Allow 1 inch clearance from furnace filter (field-supplied) to furnace.

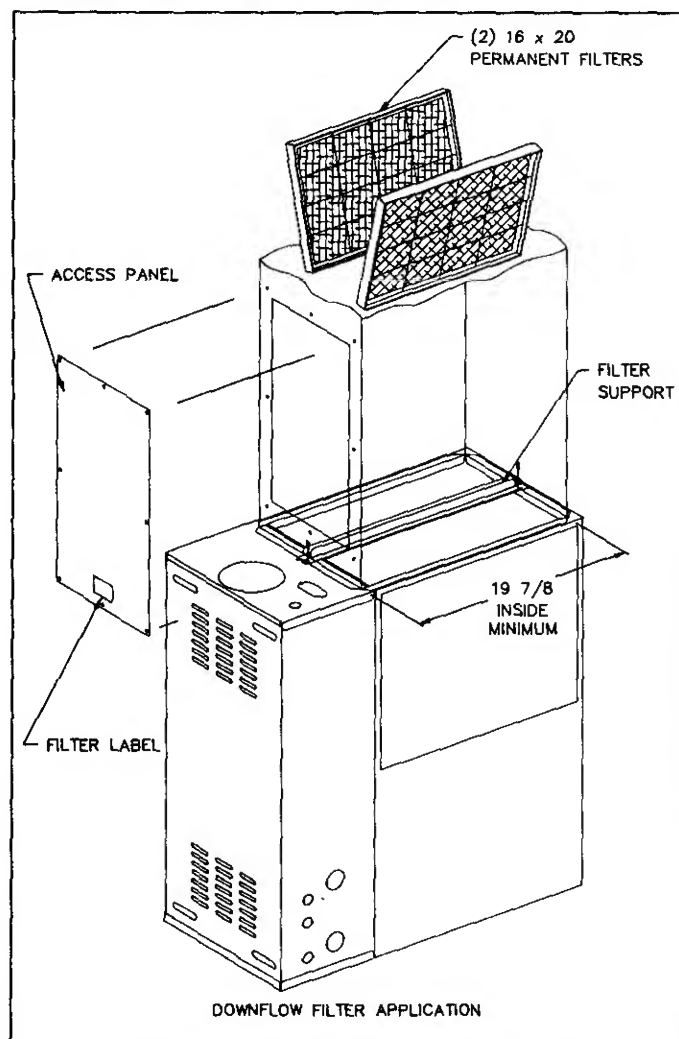
## 2. Horizontal Position.

Horizontal position should use an appropriately sized and installed return air filter grille or duct work air filter.

## 3. Downflow Position.

Downflow position furnaces use (2) 16 x 20 filters.

For downflow position, install filter support in return air plenum or use return air filter grille. Downflow filter support and filter kit is available from manufacturer.



**DOWNFLOW FILTER ARRANGEMENT  
FIGURE 31**

To inspect, replace or clean air filters, follow Users' Information Manual instructions.

## SECTION 18 — CHECKS BEFORE STARTING FURNACE.

Before starting furnace for the first time, be sure you can answer "Yes" to each of these questions:

1. Is furnace properly equipped to operate with available fuel? See Section 2.
2. Is furnace level? See Section 4.
3. Have you cleared away all loose construction and insulation materials? See Section 6.
4. Is furnace installed with proper clearances to combustible materials? See Section 6.
5. If furnace is in crawl space, is it sufficiently elevated above the ground? See section 6.
6. Does furnace have sufficient combustion and ventilation air? See Section 8.
7. Does vent system meet current National Fuel Gas Code ANSI Z223.1/NFPA 54 and local codes? See Section 9.
8. Is vent connection securely fastened to draft inducer collar? See Section 9.
9. Did you completely check gas pipe and controls for gas leaks? See Section 11.
10. Does electrical wiring follow current National Electrical Code ANSI/NFPA 70 as well as local codes? See Section 12.
11. Is furnace electrically grounded? See Section 12.
12. Is room thermostat properly installed and heat anticipator set correctly? See Section 14.
13. Is duct work system correctly sized and sealed? See Section 16.
14. Are air filters in place and correctly sized? See Section 17.
15. Are proper filter frames or filter supports installed? See Section 17.
16. On furnace installations above a 2000-foot elevation, is furnace derated properly? See Section 23.

## SECTION 19 — ADJUSTING PILOT.

Equipment needed: Save time by getting these tools before you start: Item number(s) 9,10,14,15,19 and 23 listed in Section 10.

**NOTE:** To purge gas lines, it may be necessary to operate furnace through more than one lockout cycle at start-up.

**WARNING:** You must have correct gas supply line and pilot gas pressures. Correct pressures give proper pilot ignition and burner operation. Use a "U" tube water manometer to measure actual gas pressure. Failure to accurately adjust pressure could cause a fire or explosion resulting in damage, injury or death.

### A. Gas supply line pressure.

1. Turn off gas at manual shut-off valve in gas supply line just ahead of furnace.
2. Remove inlet pressure plug from gas control.

3. Make sure valve is in off position, then install 1/8"-pipe manual shut-off valve in hole vacated by plug.
4. Attach "U" tube water manometer to 1/8"-pipe manual shut-off valve just installed.
5. Open manual shut-off valve in gas supply line just ahead of furnace.
6. Open 1/8"-pipe manual shut-off valve leading to "U" tube water manometer.
7. Turn on all gas appliances attached to gas supply line.
8. With furnace operating, read gas supply line pressure on manometer.
  - a. Gas supply line pressure must not exceed 10.5 inches W.C. for natural gas.
  - b. Gas supply line pressure must not exceed 13 inches W.C. for propane (LP) gas.
9. If gas supply line pressure is not within these limits, call gas supplier.
10. Turn off all gas appliances attached to gas supply line.

#### B. Pilot flame adjustment.

Before adjusting pilot flame, confirm that gas supply line pressure is correct, as explained in paragraph A) above, then proceed:

1. Open manual shut-off valve located in gas supply line just ahead of furnace.
2. If necessary, adjust spark gap to 3/16" as shown in Figure 32. Pilot flame should cover 1/2" of tip of flame sensor.

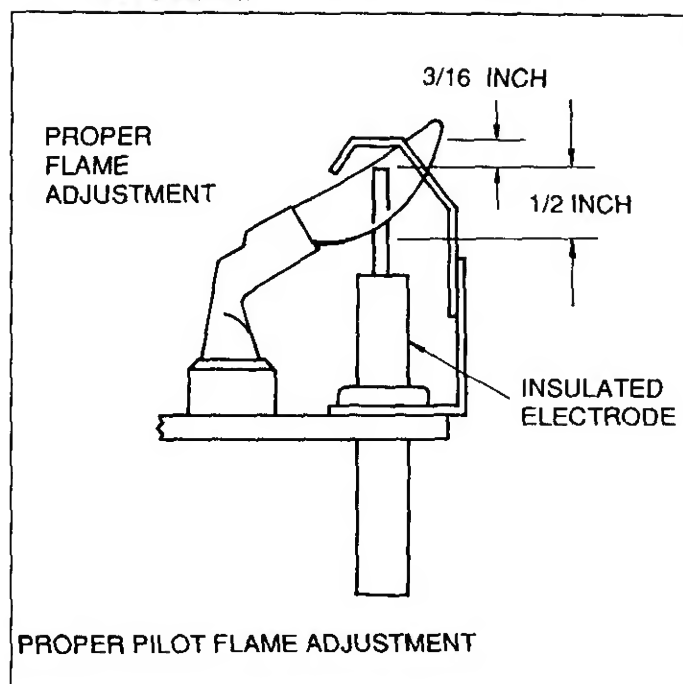


FIGURE 32

3. Disconnect pressure switch, red/yellow, #7/#8 piggy-back wire from pressure switch, terminal "N.O.".
4. Start furnace following Operating Instructions on front door. Pilot will light; after delay, inducer blower will come on, but main burners will not light.
5. Pilot flame should cover 1/2" of tip of flame sensor as shown in Figure 32.
6. If you need to adjust pilot flame, remove pilot adjustment cover screw on gas control. Save screw for reinstallation. Turn inner adjustment screw clockwise -> to decrease pilot flame; counter-clockwise <- to increase pilot flame. Install cover screw and tighten to torque of 5 inch-pounds to prevent gas leakage.
7. Shut off furnace. Connect pressure switch, red/yellow, #7/#8 piggyback wire to pressure switch, terminal "N.O.".
8. If you will not be checking gas input now, turn off gas. Use manual shut-off valve in gas supply line just ahead of furnace. Remove shut-off valve from gas control inlet pressure tap. Install pressure tap plug. Turn on gas.
9. Check pilot adjustment cover screw and gas control inlet pressure tap plug for gas leaks. Use a commercial soap solution made for leak detection.

**WARNING:** Never use an open flame to check for gas leaks. A gas leak could cause a fire or explosion, resulting in damage, injury or death.

## SECTION 20 — ADJUSTING MANIFOLD PRESSURE.

Equipment Needed: Save time by getting these tools before you start: Item number(s) 9,10,11,15,19 and 23 listed in Section 10.

**WARNING:** Correct manifold pressure is necessary for proper ignition and burner operation. Use a "U" tube water manometer to measure actual gas pressures. Failure to accurately adjust pressure could cause heat exchanger failure, asphyxiation, fire or explosion, resulting in damage, injury or death.

#### A. Normal manifold pressures (gas control outlet pressures).

Gas Supply	Normal
Natural gas	3.5 inches W.C.
Propane (LP) gas	10.0 inches W.C.

**CAUTION:** Many Installers' set Propane (LP) manifold pressure at 11.0 inches W.C. Do not do this. It could cause heat exchanger failure or nuisance callbacks.

Check gas supply line pressure first, following instructions in Section 19A.

#### B. Connect a "U" tube water manometer to measure manifold pressure:

1. Turn off gas at manual shut-off valve located in gas supply line just ahead of furnace.

2. Remove outlet pressure tap plug from gas control.
3. Make sure shut-off valve is in off position, then install 1/8"-pipe manual shut-off valve in hole vacated by plug.
4. Attach "U" tube water manometer to 1/8"-pipe manual shut-off valve just installed.
5. Turn on all gas appliances attached to gas supply line.
6. Open manual shut-off valve in gas supply line just ahead of furnace. Start furnace following Operating Instructions on front door.
7. Open 1/8"-pipe manual shut-off valve leading to manometer.
8. Read manifold pressure on manometer.
9. Make small changes in manifold pressure within allowable range (3.2 inches W.C. to 3.8 inches W.C.) by turning gas control regulator adjusting screw clockwise -> to increase pressure; turn counter-clockwise <- to decrease pressure. Make major changes in flow rate by changing main burner orifice size. See Section 23.
10. Turn off gas at manual shut-off valve in gas supply line just ahead of furnace. Install outlet pressure tap plug in gas control. Turn on gas.
11. Check regulator adjustment cover screw and gas control plug for gas leaks. Use a commercial soap solution made for leak detection.

**WARNING:** Never use an open flame to check for gas leaks. A gas leak could cause a fire or explosion resulting in damage, injury or death.

## SECTION 21 — CHECKING GAS INPUT.

Equipment Needed: Save time by getting these tools before you start: Item number(s) 11,14,15,19 and 22 listed in Section 10.

**WARNING:** Natural gas heating value (BTU/cu.ft.) can vary significantly, therefore, it is the installers' responsibility to see that BTU input to furnace is adjusted properly. Failure to do so could cause heat exchanger failure, asphyxiation, fire or explosion, resulting in damage, injury or death.

Underfiring could cause inadequate heat, excessive condensation or ignition problems. Overfiring could cause sooting, flame impingement or overheating of heat exchanger.

### A. Natural Gas.

**NOTE:** For operations above 2,000 feet elevation, follow instructions in Section 23.

Before starting natural gas input check, obtain gas heat value at standard conditions from local supplier.

1. Make sure gas piping is large enough for all appliances connected to it to operate at once without lowering main line pressure. Failure to do so could

cause lighting or burning problems on any of the appliances.

2. Make sure gas control inlet pressure does not exceed 10.5 inches W.C. Use method in Section 19A to check gas supply line pressure.
3. Make sure all other gas appliances are off. You may leave pilots on. Start furnace following Operating Instructions on front door or in Users' Information Manual.
4. As furnace warms up, watch gas supply line (gas control inlet) pressure using "U" tube water manometer installed in gas control inlet pressure tap. Natural gas supply line pressure must still not exceed 10.5 inches W.C.
5. After verifying correct gas control inlet pressure, close shut-off valve in gas control inlet pressure tap. Move manometer connection to gas control outlet pressure tap. See Section 20. Open shut-off valve in outlet pressure tap. Let furnace warm up for 6 minutes.
6. Manifold pressure should be 3.5 inches W.C. Adjust by removing regulator cover screw on gas control. Save screw for reinstallation. Turn inner adjustment screw counter-clockwise <- to decrease manifold pressure; turn clockwise -> to increase manifold pressure. Set correct manifold pressure. Install cover screw and tighten to torque of 5 inch-pounds to prevent gas leakage.
7. Locate gas meter. Determine which dial has the least cubic feet of gas and how many cubic feet per revolution it represents. This is usually one-half, one or two cubic feet per revolution.
8. With stopwatch, measure time it takes to consume two cubic feet of gas.

- a. If dial is one-half-cubic foot per revolution, measure time for four revolutions.
- b. If dial is one-cubic foot per revolution, measure for two revolutions.
- c. If dial is two-cubic feet per revolution, measure for one revolution.
- d. After determining the number of seconds for two cubic feet of gas to flow through meter, divide this time by two. This gives average time for one cubic foot of gas to flow through meter.

Example:

If it took 58 seconds for two-cubic feet to flow, it would take 29 seconds for one-cubic foot to flow.

9. a. Use this formula to calculate gas input:

$$\text{Gas Input} = \frac{\text{Gas BTU/CU.FT.} \times 3,600}{\text{seconds per hour}} \div \text{Seconds for one cubic foot of gas} = \text{Btuh}$$

**Example:**

Assume it took 29 seconds for one cubic foot of gas to flow and heating value of 1,000 BTU/ CU.FT.

$$\text{Gas Input} = \frac{1,000 \times 3,600}{29} = 124,138 \text{ Btuh}$$

If you left no other pilots on, this is the furnace gas input.

- b. If you left water heater, dryer or range pilots on, allow for them in calculating correct furnace gas input. A quick way is to allow 1,000 Btuh for a water heater. Allow 500 Btuh for dryer and 500 Btuh for each range burner pilot.

**Example:**

If you left gas water heater, dryer, four range burner pilots and one oven pilot on, allow:

Water heater pilot	1,000 Btuh
Dryer pilot	500 Btuh
4 range burner pilot	2,000 Btuh
1 range oven pilot	500 Btuh
	<hr/>
	4,000 Btuh

Subtracting 4,000 Btuh from 124,138 Btuh measured above equals 120,138 Btuh. This would be the correct furnace gas input after allowing for pilots left on.

10. Manifold pressure may be adjusted within the range of 3.2 inches W.C. to 3.8 inches W.C. to get rated input. If you cannot get rated input with manifold pressure within the allowable range, you will need to change orifices. See Section 23.
11. Turn off gas. Remove 1/8"-pipe manual shut-off valves you used. Install 1/8"-pipe plugs in gas control inlet and outlet pressure taps. Tighten to torque of 50 inch-pounds. Turn on gas. Check both pipe plugs for gas leaks. Use a commercial soap solution made for leak detection.

**WARNING:** Never use an open flame to check for gas leaks. A gas leak could cause a fire or explosion, resulting in damage, injury or death.

**B. Propane (LP) Gas.**

**WARNING:** Propane (LP) gas installations do not have gas meters to double check input rate. Measure manifold pressure adjustment with an accurate "U" tube water manometer. Failure to accurately adjust pressure could cause heat exchanger failure, asphyxiation, fire or explosion, resulting in damage, injury or death.

**NOTE:** For operation at elevations above 2,000 feet, follow instructions in Section 23.

1. Make sure you have correct pilot orifice and main burner orifices. Be sure that gas piping is large enough for all appliances connected to it to operate at once without lowering the main line pressure. Failure to do so could cause lighting or burning problems on any of the appliances.
  2. Gas control inlet pressure must be between 11 inches and 13 inches for propane (LP) gas. See Section 19A to check gas supply line pressure.
  3. Turn off all other gas appliances. Pilots may be left on. Start furnace following Operating Instructions on front door or in Users' Information Manual.
  4. As furnace warms up, watch gas supply line (gas control inlet pressure) using "U" tube water manometer in gas control inlet pressure tap. See Section 19A. Supply line pressure must still be between 11 inches and 13 inches W.C. for propane (LP) gas.
  5. After verifying correct gas control inlet pressure, close shut-off valve in gas control inlet pressure tap. Move manometer to gas control outlet pressure tap. See Section 20. Open shut-off valve in gas control outlet pressure tap. Let furnace warm up for 6 minutes.
  6. Manifold pressure should be 10.0 inches W.C. +/- 0.3 inches W.C. Adjust by removing regulator cover screw on gas control. Save screw for reinstallation. Turn inner adjustment screw counter-clockwise <- to decrease manifold pressure; turn clockwise -> to increase manifold pressure. Set correct manifold pressure. Install cover screw and tighten to torque of 5 inch-pounds to prevent gas leakage.
- CAUTION:** Many Installers' set propane (LP) manifold pressure at 11.0 inches W.C. Do not do this. It could cause heat exchanger failure or nuisance callbacks.
- WARNING:** Propane (LP) gas installations do not have gas meters to double check input rate. You must measure manifold pressure adjustment with an accurate "U" tube water manometer. Failure to accurately adjust pressure could cause heat exchanger failure, asphyxiation, fire or explosion, resulting in damage, injury or death.
7. Turn off gas before removing the 1/8"-pipe manual shut-off valves. Install 1/8"-pipe plugs in gas control inlet and outlet pressure taps. Tighten to torque of 50 inch-pounds. Turn on gas. Check both pipe plugs for gas leaks. Use a commercial soap solution made for leak detection.

**WARNING:** Never use an open flame to check for gas leaks. A gas leak could cause a fire or explosion resulting in damage, injury or death.

## SECTION 22 — ORIFICE SIZE.

See Figure 33 for initial gas orifice sizes as shipped from factory.

Initial Orifice Size		
*Input BTU/HR	Natural Gas *Orifice Size	Propane Orifice Size
All size units	2.15mm	1.30mm
*See furnace rating plate located on blower door.		

FIGURE 33

Check with your local gas supplier to determine heat value (BTU/CU.FT.) of gas in your area. Depending on your local heat value and elevation, you may need to adjust manifold pressure or change orifices to get proper gas input rate. See Section 23.

## SECTION 23 — DERATING FOR HIGH ALTITUDES.

Equipment Needed: Save time by getting these tools before you start: Item number(s) 3, 7 and 23 listed in Section 10.

### A. Installer responsibility.

For operation at elevations above 2,000 feet the den-

sity of air is reduced, therefore, the furnace should be derated at the rate of four percent (4%) for each 1,000 feet above sea level. It is the Installers' responsibility to see that the input is adjusted properly.

If the gas supplier has not already derated the gas BTU value, derating must be achieved by reducing the size of the main burner orifices. See Table 34 and 35 for proper sizing. Contact gas supplier for more information.

Adjustment of the manifold pressure to a lower pressure reading than what is specified in Section 20, **Manifold Pressure Adjustment** of this manual is considered to be an improper derate procedure. With a lower density of air and a lower manifold pressure at the burner orifice, the orifice will not aspirate the proper amount of primary air into the burner. Insufficient primary air can cause incomplete combustion, yellow tipping and quite possibly carbon build-up.

### B. New orifice size.

See appropriate chart below to determine new orifice size.

To accomplish altitude derate, a natural gas orifice kit containing the natural gas orifices indicated in Figure 34 is available through your supplier. A similar propane (LP) gas orifice kit is available. Individual orifices are also available in a convenient lot size. Use only these orifices to assure proper performance.

NATURAL GAS—ORIFICE SIZE CHART									
Gas Heat* Value BTU/CU.FT.	Elevation								
	Up to to 2000 Feet	2001 to 3000 Feet	3001 to 4000 Feet	4001 to 5000 Feet	5001 to 6000 Feet	6001 to 7000 Feet	7001 to 8000 Feet	8001 to 9000 Feet	9001 to 10000 Feet
800-849	2.35mm	2.30mm	2.30mm	2.25mm	2.20	2.20mm	2.15mm	2.10mm	2.05mm
850-899	2.30mm	2.25mm	2.20mm	2.20mm	2.15mm	2.10mm	2.10mm	2.05mm	2.00mm
900-949	2.25mm	2.20mm	2.15mm	2.15mm	2.10mm	2.05mm	2.05mm	2.00mm	1.95mm
950-999	2.20mm	2.15mm	2.10mm	2.05mm	2.05mm	2.00mm	1.95mm	1.95mm	1.90mm
1000-1049	2.15mm	2.10mm	2.05mm	2.05mm	2.00mm	2.00mm	1.95mm	1.90mm	1.85mm
1050-1100	2.10mm	2.05mm	2.00mm	2.00mm	1.95mm	1.90mm	1.90mm	1.85mm	1.85mm

\*At standard conditions: 30.0 inches Mercury, 60°F, Saturated.

NOTE: Shaded orifices above are not included in natural gas orifice kit. They are available separately.

FIGURE 34

PROPANE (LP) GAS—ORIFICE SIZE CHART									
Gas Heat* Value BTU/CU.FT.	Elevation								
	Up to to 2000 Feet	2001 to 3000 Feet	3001 to 4000 Feet	4001 to 5000 Feet	5001 to 6000 Feet	6001 to 7000 Feet	7001 to 8000 Feet	8001 to 9000 Feet	9001 to 10000 Feet
40,000-140,000	1.30mm	1.25mm	1.25mm	1.20mm	1.20mm	1.20mm	1.15mm	1.15mm	1.10mm

FIGURE 35

NOTE: All orifices above are included in propane (LP) gas orifice kit.



### C. Changing orifices.

**WARNING:** Before changing orifices, turn off electrical power and gas. Failure to do so could result in electrical shock or gas leak, resulting in damage, injury or death.

1. Set room thermostat to its lowest or off setting.
2. Turn off electricity at electrical disconnect switch next to furnace.
3. Turn off manual shut-off valve in gas supply line just ahead of furnace.
4. Turn gas control knob clockwise -> to OFF position.
5. Starting with burner farthest from gas control, remove burner screws and burners. Burners overlap. Burner farthest from gas control is on top. See Figure 36.
6. Remove original gas orifices.
7. First, hand thread new orifices into manifold. Do not cross-thread; then tighten to torque of 50 inch-pounds.

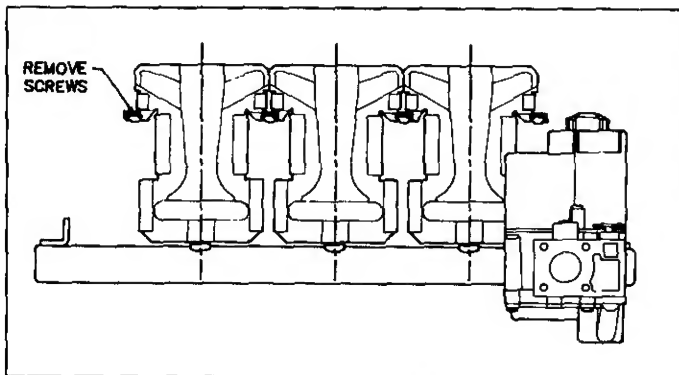


FIGURE 36

8. Replace burners in reverse order from instructions in Step 5.
9. Check burner carryover alignment. They should be touching but not overlap adjacent burner. Replace screws.
10. Turn gas control knob counter-clockwise <- to ON position.
11. Open manual shut-off valve in gas supply line just ahead of furnace.
12. Set room thermostat to its highest setting.
13. Turn on electricity at electrical disconnect switch located next to furnace.
14. Check for gas leaks using commercial soap solution made for leak detection.

**WARNING:** Never use an open flame to check for gas leaks. A gas leak could cause a fire or explosion resulting in damage, injury or death.

15. Check gas input following Section 21.

## SECTION 24 — ADJUSTING BLOWER SPEED..

**CAUTION:** Heating speed tap should not be reduced below initial factory setting. Reducing speed tap setting may result in inadequate air circulation, and could cause excessive air temperature rise through furnace. This could cause high-temperature limit switch to cycle burners on and off. This could reduce furnace efficiency and shorten life of heat exchanger and blower motor.

1. All models have four blower speeds available for use.

Motor speed designations are:

- #1. High Speed (HI)
- #2. Medium High Speed (MH)
- #3. Medium Low Speed (ML)
- #4. Low Speed (LOW)

2. Determine initial heating and cooling speeds in system design stage. See Product Data sheet for air-flow data. Depending on test results performed in Sections 25 and 26, you may need to change blower motor speed.
3. Turn off electricity at electrical disconnect switch next to furnace.

**WARNING:** Failure to turn off electrical power to furnace before changing blower motor speed could cause electrical shock resulting in damage, injury or death.

4. Make blower speed changes at connector block located at side of blower door. See Figure 37A.

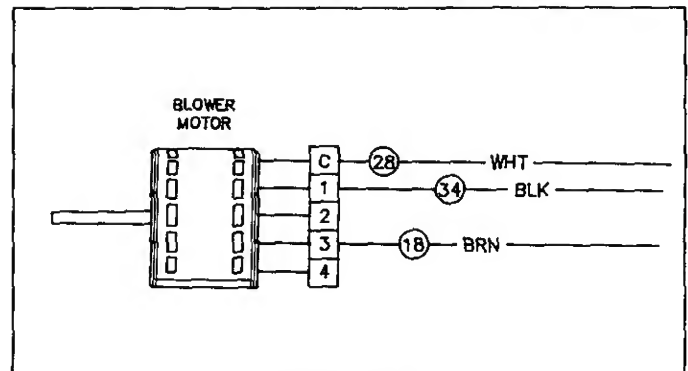


FIGURE 37A

5. Never change the "C" common (WHT) wire.
6. To change cooling speed, black wire is moved to desired speed. Cooling speed is controlled through blower motor relay (BMR).
7. To change heating speed, brown wire is moved to desired speed. Heating speed is controlled through time delay relay (TDR). Heating speed should not be reduced below initial factory setting.



8. Turn on electricity at electrical disconnect switch located next to furnace.

## SECTION 25 — MEASURING DUCT WORK STATIC PRESSURE.

Equipment Needed: Save time by getting these tools before you start: Item number(s) 20 listed in Section 10.

**CAUTION:** High duct work static pressure may cause low airflow resulting in poor heating performance and reduced heat exchanger life. Low airflow may also cause poor cooling performance.

### A. Preparing to measure duct work static pressure.

1. Open supply air registers and return air grilles. Make sure the registers and grilles are free of obstruction from rugs, carpets, drapes or furniture.
2. Set balancing dampers in supply duct system.
3. Check duct work for obstructions or leaks.
4. Make sure filters are clean and in place. See Section 17 for filter information.
5. Make sure that blower speed taps are set for proper heating and cooling. For heating operation, initial speed tap should be set in accordance with Figure 37B. For cooling operation, initial speed tap should be set in accordance with Figure 38. Refer to Section 24 for adjusting blower speed.

Air Temperature Rise Range and Heating Operation Speed Taps		
**BTU/HR / Motor Input / HP	Air Temperature Rise Range (°F)	Heating Operation *Speed Tap
40,000 / 1/4	50-80	LO
40,000 / 1/3	30-60	LO
60,000 / 1/4	45-75	ML
60,000 / 1/3	45-75	LO
60,000 / 1/2	35-65	LO
80,000 / 1/4	50-80	MH
80,000 / 1/3	40-70	MH
80,000 / 1/2	50-80	LO
80,000 / 3/4	40-70	LO
100,000 / 1/3	55-85	MH
100,000 / 1/2	50-80	ML
100,000 / 3/4	40-70	ML
120,000 / 1/2	45-75	MH
120,000 / 3/4	45-75	MH
140,000 / 3/4	45-75	MH
140,000 / 3/4	50-80	MH

\* These are initial Factory Settings.  
 \*\* See Furnace Rating Plate for BTU/HR input and Motor H.P.

FIGURE 37B

### a. Heating.

1. Measure duct work static pressure with circulating air blower on heating speed. Follow instructions below.
2. Measure air temperature rise with circulating air blower on heating speed. See Section 26.

### b. Air Conditioning.

1. Measure duct work static pressure with circulating air blower on air conditioning speed. Follow instructions below.
2. Measure air temperature rise with circulating air blower on heating speed. See Section 26.

Air Conditioning Operation Speed Tap Settings with 0.5" W.C. Ductwork Static Pressure							
*BTU/HR / Motor Input / HP	Air Conditioning Tonnage						
	1—1/2	2	2—1/2	3	3—1/2	4	5
40,000 / 1/4	MH	HI	—	—	—	—	—
40,000 / 1/3	—	ML	MH	HI	—	—	—
60,000 / 1/4	MH	HI	—	—	—	—	—
60,000 / 1/3	—	ML	MH	HI	—	—	—
60,000 / 1/2	—	—	—	ML	MH	HI	—
80,000 / 1/4	HI	HI	—	—	—	—	—
80,000 / 1/3	LO	ML	HI	HI	—	—	—
80,000 / 1/2	—	—	—	ML	MH	HI	—
80,000 / 3/4	—	—	—	—	ML	MH	HI
100,000 / 1/3	LO	ML	HI	HI	—	—	—
100,000 / 1/2	—	LO	MH	MH	HI	—	—
100,000 / 3/4	—	—	—	LO	MH	MH	HI
120,000 / 1/2	—	—	LO	ML	HI	HI	—
120,000 / 3/4	—	—	—	LO	ML	HI	HI
140,000 / 3/4	—	—	LO	ML	HI	HI	—
140,000 / 3/4	—	—	—	LO	ML	HI	HI

\* See furnace rating plate for BTU/HR input and motor H.P.

This table only gives initial speed tap settings for installations with ductwork static pressure of 0.5" W.C. figuring 400 CFM per ton of air conditioning. Ductwork with higher than 0.5" W.C. static pressure will cause reduced airflow and these speed tap settings will not be correct. To determine correct speed tap settings at ductwork static pressures above 0.5" W.C., see Product Data Sheet.

FIGURE 38

### B. Measuring duct work static pressure.

1. Place slope gauge near furnace where level and adjust scale to read 0.00 inches W.C.
2. Insert one static pressure tap into supply air transition duct between furnace and cooling coil or in the supply air plenum for heating only systems. Insert other static pressure tap in return air plenum. See Figure 39.

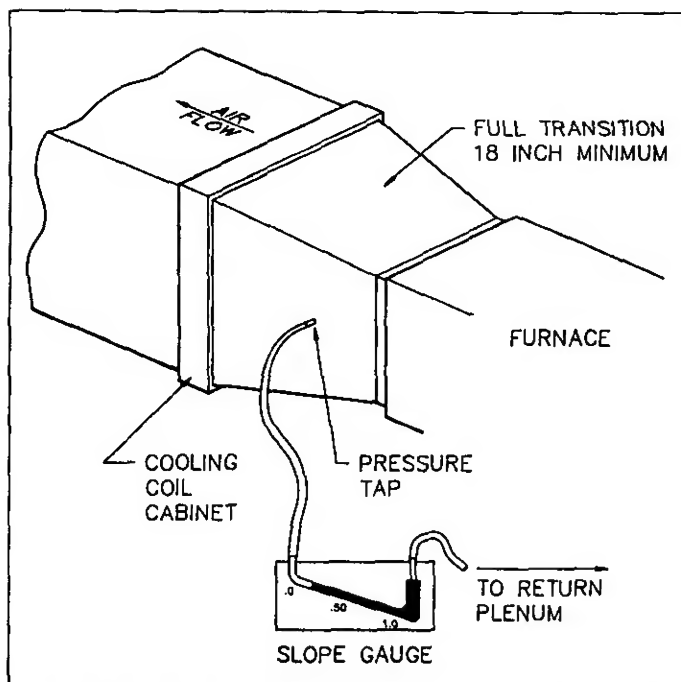


FIGURE 39

3. Connect pressure tap attached to supply air transition duct (warm air supply plenum) to positive pressure side of slope gauge (bottom of scale). See Figure 39.
4. Connect pressure tap attached to return air plenum to negative pressure side of slope gauge (top of scale). See Figure 39.
5. Start blower on cooling speed by jumping terminals "R" and "G" on 24 volt terminal strip located on furnace control box.
6. With blower running, read duct work static pressure from slope gauge.

**NOTE:** If air filter location is upstream of return air pressure tap, duct work static pressure must be adjusted by subtracting 0.08 inches W.C. to get actual duct work static pressure.

$$\text{Duct Work Static Pressure} = \text{Measured Pressure} - 0.08 \text{ inches W.C.}$$

7. Duct work static pressure should not exceed 0.5 inches W.C. in order to insure proper volume of air flow.
8. Remove jumper wire between terminals "R" and "G" on 24 volt terminal strip. Remove pressure taps and seal holes in duct work. Failure to seal holes could result in reduced system performance.

## SECTION 26 — MEASURING AIR TEMPERATURE RISE.

**Equipment Needed:** Save time by getting these tools before you start: Item number(s) 21 listed in Section 10.

### A. Preparing to measure air temperature rise.

Follow Steps 1 through 5 in Section 25A of this Manual.

### B. Measuring air temperature rise.

Air temperature rise (warm air supply temperature minus cold air return temperature) must be within allowable air temperature rise range specified on furnace rating plate and in Figure 37B.

Figure 37B shows heating operation speed tap. Furnace is set on this speed tap when shipped from factory.

1. Place thermometer in supply air plenum approximately 2 feet from furnace. Locate thermometer tip in center of plenum to insure proper temperature measurement.
2. Place thermometer in return air duct approximately 2 feet from furnace. Locate thermometer tip in center of duct to insure proper temperature measurement.
3. Set room thermostat on highest temperature setting. Operate furnace 6 minutes. Record supply air and return air temperatures.
4. Calculate air temperature rise by subtracting return air temperature from supply air temperature.
5.
  - a. If air temperature rise is below maximum temperature rise, heating system has sufficient air flow.
  - b. If air temperature rise is above maximum temperature rise specified in Figure 37B, more heating air flow is needed. Change blower heating speed to a higher setting. Follow instructions in Section 24 to adjust blower speed.

**CAUTION:** Operating furnace above maximum air temperature rise may cause poor heating performance and decreased heat exchanger life.

6. Heating speed tap should not normally be reduced below initial factory setting. Some duct system configurations and supply register locations may result in "cold blow". Setting heating speed tap to next lower speed may resolve this issue.
7. After making heating airflow adjustments, you must check air temperature rise following Steps 3 and 4 above to verify that resulting air temperature is within allowable range.
8. If air temperature rise is still above that specified on furnace rating plate and in Figure 37B, check duct work design with a qualified heating engineer. It may be necessary to resize the duct work. Recheck air temperature rise after revising duct system.
9. Set room thermostat to desired setting.
10. Remove thermometers and seal duct work holes. Failure to seal holes could result in reduced system performance.

## SECTION 27 — CHECKING CONTROLS.

Equipment Needed: Save time by getting these tools before you start: Item number(s) 3 and 18 listed in Section 10.

Before leaving the work site, check to see that all controls are functioning properly.

Follow these steps:

1. Turn off electricity at electrical disconnect switch next to furnace.
2. Turn gas control knob clockwise → to OFF position.
3. Connect a "U" tube water manometer to gas control outlet (manifold) pressure tap.
4. Set room thermostat to its highest temperature.
5. Turn on electricity at electrical disconnect switch located next to furnace. Electronic ignition lockout module should start to spark pilot ignitor, but pilot burner should not light. Manifold pressure should remain at zero.
6. Electronic ignition lockout module should spark pilot ignitor for given lockout time of module and go into lockout mode. Lockout time for Honeywell S8600H is 90 seconds maximum.

**NOTE:** Honeywell electronic ignition lockout module will stop sparking when module locks out.

7. Turn off electricity at electrical disconnect switch located next to furnace. Turn gas control knob counter-clockwise ← to ON position. Wait 10 seconds for electronic ignition lockout module to reset.
8. Turn on electricity at electrical disconnect switch located next to furnace. Pilot should light from spark and ignite burners. Wait for main blower to start.

**NOTE:** To purge gas lines, it may be necessary to operate furnace through more than one lockout cycle at start-up.

9. Cycle electrical disconnect switch next to furnace on and off. Watch at least three ignition cycles. Pilot should light from spark and light main burners within 10 seconds.
10. Burner flames should look the same with circulation blower on and off. If not, turn gas control knob clockwise → to OFF position.
11. Turn off electricity at electrical disconnect switch located next to furnace. Disconnect all room thermostat wires at control box terminal strip. To start blower on cooling speed, jump terminal strip, terminals "R" and "G". Turn on electricity at electrical disconnect switch next to furnace.
12. Using a match flame check for air leaks between bulkhead and blower deck, under burners and up each side where bulkhead mounts to casing. Tighten screws until air leaks stop.

13. Turn off electricity at electrical disconnect switch located next to furnace. Remove jumper from terminal strip, terminals "R" and "G". Reconnect all room thermostat wires to original terminal strip, terminals. See Section 13.
14. Remove "U" tube water manometer from gas control and replace outlet pressure tap. Turn gas control knob counter-clockwise ← to ON position.
15. Turn on electricity at electrical disconnect switch next to furnace. With main burners and blower operating, block off all return air grilles to restrict return air. Wait for primary limit control to cycle burners off.
16. Remove all restrictions from return air grilles. When primary limit cools, burners should automatically reignite.
17. Set room thermostat to desired setting.

## SECTION 28 — BLOWER TIMINGS.

Equipment Needed: Save time by getting these tools before you start: Item number(s) 5 listed in Section 10.

1. Blower on-time setting of heating relay is fixed at 20 to 30 seconds and is not field adjustable.
2. Blower off-time setting is adjustable through a range of 60 to 180 seconds. Blower off-time is factory set at 180 seconds.
3. If a shorter blower off-time is desired:
  - a. Turn off electricity at electrical disconnect switch located next to furnace.
  - b. Remove control box cover and locate heating relay in control box. Turn the dial counter clockwise ← to desired setting.

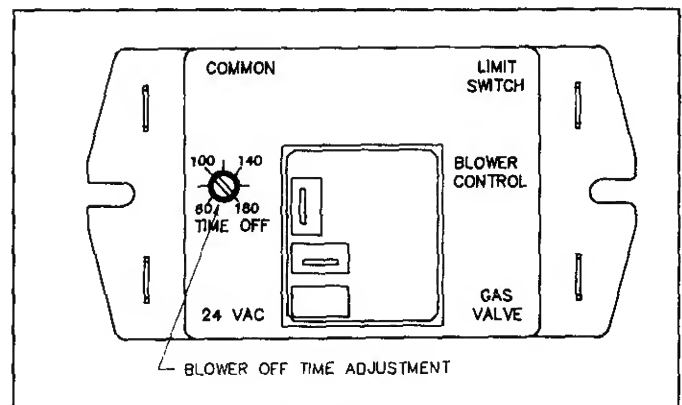


FIGURE 40

4. Install control box cover.
5. Turn on electricity at electrical disconnect switch next to furnace.

## SECTION 29 — MAINTAINING FURNACE IN GOOD WORKING ORDER.

**WARNING:** Follow these procedures before inspecting furnace.

- Turn room thermostat to its lowest or off setting.
- Turn off manual gas shut-off valve.
- Wait at least five minutes for furnace to cool if it was recently operating.
- Turn off furnace electrical power; failure to do so could result in injury or death.

**WARNING:** Use replacement parts listed in parts list. Failure to do so could cause improper furnace operation, resulting in damage, injury or death.

Perform periodic preventive maintenance once before heating season begins and once during heating season. Inspect, clean, and repair as needed following items:

1. All combustion and ventilation air openings into furnace space.
2. All burner combustion air openings.
3. All burners, pilot, collector box, draft inducer assembly and complete vent system.
4. All gas pipes leading to furnace.
5. All electrical wiring and connections, including electrical ground.
6. All supply air and return air ducts for obstructions, air leaks and loose insulation.
7. Blower housing, motor and wheel, air filters, air conditioning and draft inducer motor. Blower motor and inducer motor do not require oiling.

A qualified service technician should follow these steps to remove blower assembly.

- a. On downflow furnaces, remove vent pipe inside furnace.
- b. Disconnect wires from low voltage terminal strip on control box.
- c. Remove two screws holding control box to the side brackets.
- d. Remove blower door.
- e. Locate connector block beside blower door on control box side. Remove it by squeezing locking ears of connector block. See Figure 41.
- f. Disconnect wires to limit switches on blower housing.
- g. On dual blower wheel models, disconnect wires to door switch.

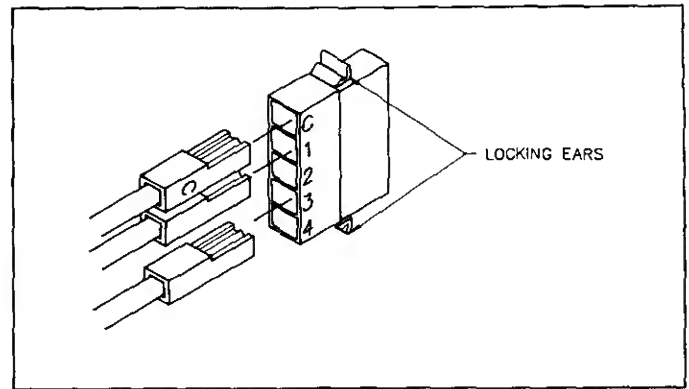


FIGURE 41

- h. Remove screws holding blower assembly to blower deck.
- i. 1. Blower assembly will now slide out. DO NOT damage limit switches on bottom of blower housing.  
2. After cleaning blower assembly, reassemble in reverse order making sure speed selections are in original positions.
8. Assure the furnace is operating properly and safely.

## SECTION 30 — GETTING OTHER INFORMATION AND PUBLICATIONS.

These publications can help you install the furnace. You can usually find these at your local library or buy them directly from the publisher. Be sure to consult current edition of each standard.

National Fuel Gas Code	ANSI Z223.1/NFPA 54
National Electrical	ANSI/NFPA Code 70
Standard for the installation of Warm Air Heating and Air Conditioning Systems	ASHRAE/NFPA 90
Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances	NFPA 211

For more information, contact these publishers:

ANSI:	AMERICAN NATIONAL STANDARDS INSTITUTE 1430 Broadway New York, NY 10018 (212) 354-3300
ASHRAE:	AMERICAN SOCIETY OF HEATING REFRIGERATING AND AIR CONDITIONING ENGINEERS, INC. 1791 Tullie Circle N.E. Atlanta, GA 30329 (404) 636-8400
NFPA:	NATIONAL FIRE PROTECTION ASSOCIATION Batterymarch Park Quincey, MA 02269 (617) 770-3000



NOTES:



## **VENTING TABLES CATEGORY 1 CENTRAL FURNACES**

# **INFORMATION**



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REVISED: JULY, 1991



# **GAMA VENTING TABLES FOR CATEGORY I CENTRAL FURNACES**

This booklet contains new venting tables designed specifically for use with Category I central furnaces. These tables are unique, in that, industry wide venting tables now exist for fan-assisted combustion system central furnaces. Venting tables for these types of appliances are not contained in the National Fuel Gas Code (NFPA 54/ANSI Z223.1-1988).

All requirements contained in this booklet apply to both Category I drafthood equipped central furnaces as well as fan-assisted combustion system central furnaces. At no time should a venting system for a listed Category II, III, or IV central furnace be sized with these tables. The National Fuel Gas Code (NFPA 54/ANSI Z223.1-1988) may also be used to size venting systems for drafthood equipped central furnaces. However, at this time, the National Fuel Gas Code does not include alternate sizing methods for fan-assisted combustion systems. **Therefore, until engineering data is developed to allow alternate sizing methods for Category I fan-assisted central furnaces, the enclosed venting tables must be used for fan-assisted combustion system central furnaces.** These tables apply to venting single appliances and common venting multiple appliances in both metal and masonry chimneys.

The new venting tables were developed by Battelle under contract (GRI-5088-245-1728) to the Gas Research Institute (GRI). The computer program (VENT-II) developed by Battelle Columbus generated the venting tables in this booklet and this procedure has been accepted by the American Gas Association Laboratories as an appropriate engineering methodology for determining venting requirements of Category I central furnaces.

For your information, the general venting requirements listed in this booklet are not intended to be used as complete installation instructions and represent only a partial list of venting considerations.

For venting applications that fall outside the parameters of the new venting tables, refer to the furnace manufacturer's complete installation instructions, the specific vent manufacturer's complete installation instructions, and state and local codes.

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# VENTING REQUIREMENTS FOR CATEGORY I APPLIANCES

## I. INTRODUCTION

This booklet contains the current definitions, instructions, and tables necessary to vent today's modern Category I Gas Fired Appliance. A variety of definitions of new terms describing today's gas appliances are included to supplement the actual venting tables which have been generated to correctly vent various combinations of Category I Appliances using Type B or single-wall metal vent connectors attached to Type B vents or masonry chimneys. Tables are also included covering similar venting material combinations when applied to common venting arrangements of two or more appliances.

Finally, a series of examples are presented demonstrating how the vent tables are used to size the vent connector and the vertical vent for a variety of typical applications.

## II. DEFINITION OF TERMS

"Fan Assisted Combustion System"

An appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber and/or heat exchanger.

"FAN Min"

refers to the minimum appliance input rating of a Category I appliance with a fan-assisted combustion system that could be attached to the vent.

"FAN Max"

refers to the maximum appliance input rating of a Category I appliance with a fan-assisted combustion system that could be attached to the vent.

"NAT Max"

refers to the maximum appliance input rating of a Category I appliance equipped with a draft hood that could be attached to the vent. There are no minimum appliance input ratings for draft hood-equipped appliances.

"FAN+FAN"

refers to the maximum combined input rating of two or more fan-assisted appliances attached to the common vent.

"FAN+NAT"

refers to the maximum combined input rating of one or more fan-assisted appliance and one or more draft hood-equipped appliance attached to the common vent.

"NAT+NAT"

refers to the maximum combined input rating of two or more draft hood-equipped appliances attached to the common vent.

"NR"

means not recommended due to potential for condensate formation and/or pressurization of the venting system.

"NA"

means not applicable due to physical or geometric constraints.

DraftHood

A device built into an appliance, or made a part of the vent connector from an appliance, which is designed to (1) provide for the ready escape of the flue gases from the appliance in the event of no draft, backdraft, or stoppage beyond the draft hood, (2) prevent a backdraft from entering the appliance, and (3) neutralize the effect of stack action of the chimney or gas vent upon the operation of the appliance.

Vent

A passageway used to convey flue gases from gas utilization equipment, or their vent connectors, to the outside atmosphere.

Vent Connector

The pipe or duct which connects a fuel-gas burning appliance to a vent or chimney.

Flue Collar

That portion of an appliance designed for the attachment of a draft hood, vent connector, or venting system.

Categorized Vent Diameter

The minimum vent diameter permissible for Category I appliances to maintain a nonpositive vent static pressure when tested in accordance with nationally recognized standards.

### 111. GENERAL VENTING REQUIREMENTS

All requirements contained in this document apply to both Category I draft hood equipped and fan-assisted combustion appliances. At no time should a venting system for a listed Category II, III, or IV appliance be sized with these Tables. The alternate sizing methods described in the National Fuel Gas Code (NFPA54/ANSI Z223.1-1988) may also be used to size the venting system for a draft hood equipped appliance. At this time, alternate sizing methods have not been developed for fan-assisted appliances. Therefore, until engineering data is developed to allow alternate sizing methods for Category I fan-assisted appliances, the vent tables must be used.

- 1) The venting tables included in this instruction apply to vents and chimneys internal to the structure below the roof line. Exterior chimneys or vents not enclosed by the structure or a chase below the roof line may experience continuous condensation depending on locality. Consult local gas utility, appliance manufacturer and/or local codes. A chimney with one or more sides exposed to the outside of the structure is considered to be an exterior chimney. A Type B or listed chimney lining system passing through an unused masonry chimney flue is not considered to be exposed to the outdoors
- 2) If the vent or connector size determined from the tables is smaller than the appliance draft hood outlet or flue collar, the smaller size may be used provided:
  - a) The total vent height "H" is at least 10 FT.
  - b) Vents or connectors for appliance draft hood outlets or flue collars 12 inches in diameter or smaller are not reduced more than one table size (e.g. 12 inches to 10 inches is a one size reduction).
  - c) Vents or connectors for appliance draft hood or flue collars above 12 inches in diameter are not reduced more than two table sizes (e.g. 24 inches to 20 inches is a two size reduction).
  - d) The maximum capacity listed in the tables for a fan-assisted appliance is reduced by 10% (0.90 x maximum capacity).
  - e) The draft hood outlet is greater than 4 inches in diameter. Do not connect a 3 inch diameter vent or connector to a 4 inch diameter draft hood outlet. This provision does not apply to fan-assisted appliances.

- 3) Single appliance venting configurations with zero lateral lengths, Tables 1 & 2, are assumed to have no elbows in the vent system. For all other vent configurations, the vent system is assumed to have two 90° elbows. For each additional 90° elbow, or equivalent\* beyond two, the maximum capacity listed in the venting table should be reduced by 10 percent (0.90 x maximum listed capacity).

\* Two 45° elbows are equivalent to one 90° elbow.

- 4) The common venting Tables 3, 4, 7, & 8 were generated using a maximum horizontal vent connector length of 1 1/2 feet (18 inches) for each inch of connector diameter as follows:

CONNECTOR DIAMETER (INCHES)	MAXIMUM HORIZONTAL CONNECTOR LENGTH (FEET)
3	4 1/2
4	6
5	7 1/2
6	9
7	10 1/2
8	12
9	13 1/2
10	15
12	18
14	21
16	24
18	27
20	30
22	33
24	36

The vent connector should be routed to the vent utilizing the shortest possible route. Connectors with longer horizontal lengths than those listed above are possible under the following conditions:

- a. The maximum capacity (Fan Max. or Nat Max.) of the vent connector shall be reduced 10% for each additional multiple of the length listed above. For example, the maximum length listed above for a 4 inch connector is 6 feet. With a connector length greater than 6 feet but not exceeding 12 feet, the maximum capacity must be reduced by 10% (0.90 x maximum vent connector capacity). With a connector length greater than 12 feet but not exceeding 18 feet, the maximum capacity must be reduced by 20% (0.80 x maximum vent capacity).

- b. The minimum capacity (Fan Min.) shall be determined by referring to the corresponding single appliance table (Tables 1 and 2). In this case, for each appliance the entire vent connector and common vent from the appliance to the vent termination would be treated as a single appliance vent, as if the other appliances were not present.

- 5) If vent connectors are combined prior to entering the common vent, the maximum common vent capacity listed in the common venting tables must be reduced by 10%, the equivalent of 1 (one) 90° elbow (0.90 x maximum common vent capacity). See Figure 7: The horizontal length of the common vent connect or manifold (L) should not exceed 1-1/2 feet (18 inches) for each inch of common vent connector manifold diameter.
- 6) If the common vertical vent is offset as shown in Figure 8, the maximum common vent capacity listed in the common venting tables should be reduced by 20%, the equivalent of 2 (two) 90° elbows (0.80 x maximum common vent capacity). The horizontal length of the offset shall not exceed 1 1/2 feet for each inch of common vent diameter.
- 7) The common vent diameter must always be at least as large as the largest vent connector diameter. All interconnection fittings must also be the same size as the common vent.
- 8) Type B gas vents shall terminate above the roof surface with a listed cap or a listed roof assembly in accordance with the terms of their respective listings and the vent manufacturer's instructions.

#### VENT CAPS 12" AND SMALLER

Listed gas venting systems using listed vent caps 12" and smaller in size may terminate in accordance with the VENT TERMINATION TABLE. (SEE FIGURE 1)

#### VENT CAPS LARGER THAN 12"

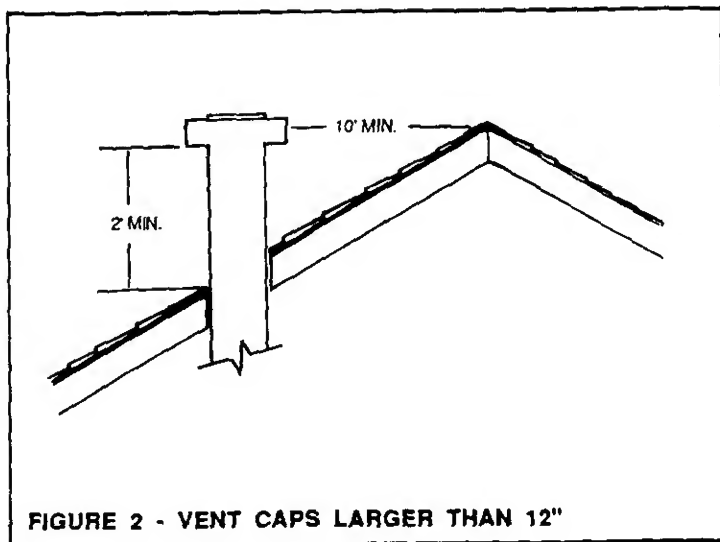
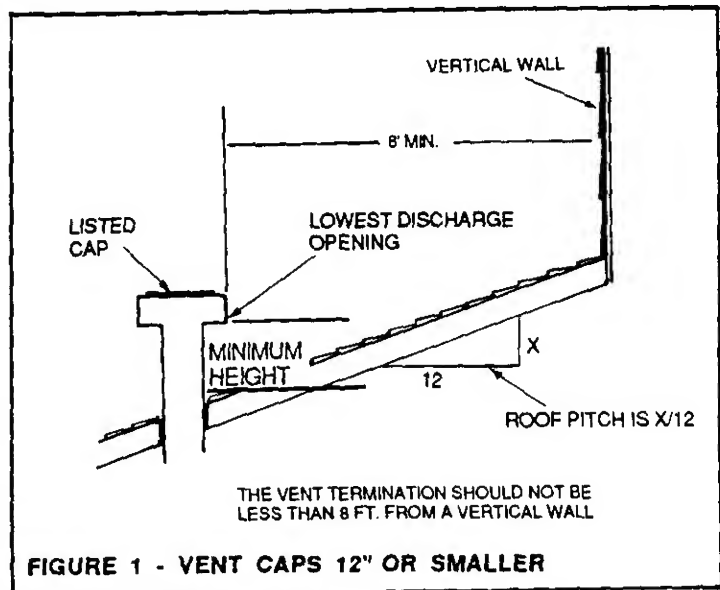
Listed vent caps larger than 12" must be located at least 2 feet above the highest point and at least 2 feet higher than any portion of a building within a horizontal distance of 10 Feet. (SEE FIGURE 2)

- 9) Use sea level input rating when determining maximum capacity for high altitude installation. Use actual input rating for determining minimum capacity for high altitude installation.

**GAS VENT TERMINATION TABLE**

ROOF PITCH	MINIMUM HEIGHT
FLAT TO 7/12	1.0 FEET *
OVER 7/12 TO 8/12	1.5 FEET
OVER 8/12 TO 9/12	2.0 FEET
OVER 9/12 TO 10/12	2.5 FEET
OVER 10/12 TO 11/12	3.25 FEET
OVER 11/12 TO 12/12	4.0 FEET
OVER 12/12 TO 14/12	5.0 FEET
OVER 14/12 TO 16/12	6.0 FEET
OVER 16/12 TO 18/12	7.0 FEET
OVER 18/12 TO 20/12	7.5 FEET
OVER 20/12 TO 21/12	8.0 FEET

\* THIS REQUIREMENT COVERS MOST INSTALLATIONS



- 10) No portion of the venting system can extend into, or pass through any circulating air duct or plenum.
- 11) All vent pipe passing through floors, walls, and ceilings must be installed with the listed clearance to combustible materials and be fire stopped according to local codes. In the absence of local codes, refer to NFPA (Z223.1)
- 12) Vent connectors serving Category I appliances shall not be connected to any portion of mechanical draft systems operating under positive pressure such as Category III or IV Venting Systems.
- 13) A Category I appliance must never be connected to a chimney that is servicing a solid fuel appliance. If a fireplace chimney flue is used to vent this appliance, the fireplace opening must be permanently sealed.
- 14) A vent connector shall be supported without any dips or sags and shall slope a minimum of 1/4 inch per lineal foot of connector, back towards the appliance.
- 15) Vent connectors shall be firmly attached to drafthood outlets or flue collars by sheet-metal screws or other approved means, except vent connectors of listed Type B vent material which shall be assembled in accordance with the manufacturer's instructions. Joints between sections of single wall connector piping shall be fastened by sheet-metal screws or other approved means.
- 16) When the vent connector used for Category I appliances must be located in or pass through a crawl space or other area which may be cold, that portion of the vent connector shall be of listed double-wall Type B vent material or material having equivalent insulation qualities.
- 17) The entire length of single wall metal vent connector shall be readily accessible for inspection, cleaning, and replacement.
- 18) For appliances with more than one input rate, the minimum vent or connector (Fan Min) capacity determined from the tables shall be less than the lowest appliance input rating and the maximum vent or connector (Fan or Nat Max.) capacity determined from the tables shall be greater than the highest appliance input rating.

19) For single appliance vents:

- a) If the vertical vent or tile lined chimney has a larger diameter or flow area than the vent connector, use the vertical vent diameter to determine the minimum vent capacity and the vent connector diameter to determine the maximum vent capacity. The flow area of the vertical vent, however, shall not exceed 7 times the flow area of the listed appliance categorized vent area, drafthood outlet area or flue collar area unless designed in accordance with approved engineering methods. See Table 9 for calculated areas.

b) For multiple appliance vents:

The flow area of the largest section of vertical vent or chimney shall not exceed 7 times the smallest listed appliance categorized vent area, flue collar area, or draft hood outlet area unless designed in accordance with approved engineering methods. See Table for calculated areas.

$$\text{Maximum vent or tile lined chimney flow area} = \frac{\pi(D)^2}{4} \times 7$$

\* Drafthood outlet diameter, flue collar diameter, or listed appliance categorized vent diameter.

- c) In no case, shall the vent connector be upsized more than 2 consecutive table size diameters over the size of the drafthood outlet, flue collar outlet, or listed appliance categorized vent. **Example:** An appliance with a 4 inch diameter flue outlet collar or drafthood outlet cannot be vented with a connector diameter larger than 6 inches.

- 20) Masonry chimneys used to vent Category I central furnaces must be either tile-lined or lined with a listed metal lining system or dedicated gas vent. Unlined masonry chimneys are prohibited. (See Note 1).

- 21) A fan assisted furnace may be common vented into an existing masonry chimney provided:

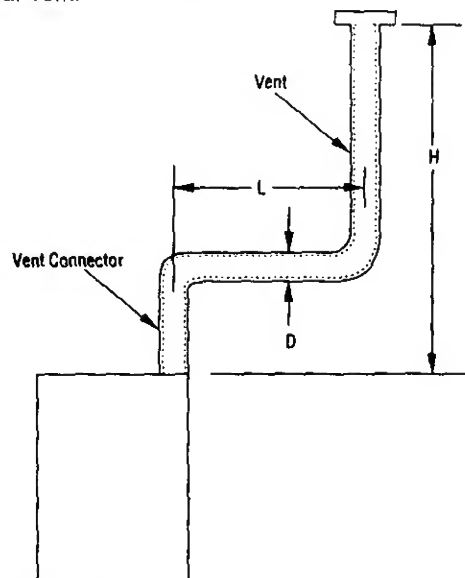
- a. The chimney is currently serving at least one drafthood equipped appliance.
- b. The vent connectors and chimney are sized in accordance with Tables 7 & 8.

SINGLE APPLIANCE VENTING OF A FAN ASSISTED FURNACE INTO A TILE LINED, MASONRY CHIMNEY IS PROHIBITED. THE CHIMNEY MUST FIRST BE LINED WITH EITHER TYPE B VENT SIZED IN ACCORDANCE WITH TABLES 1 OR 2 OR A LISTED, SINGLE WALL, METAL LINING SYSTEM, SIZED IN ACCORDANCE WITH NOTE 22.

- 22) Listed, corrugated metallic chimney liner systems in masonry chimneys shall be sized by using Tables 1 or 2 for dedicated venting and Tables 3 or 4 for common venting with the maximum capacity reduced by 0.20% (0.80 x maximum capacity) and the minimum capacity as shown in the applicable table. Corrugated metal vent systems installed with bends or offsets require additional reduction of the vent maximum capacity (See Note 6).
- 23) For multiple units of gas utilization equipment all located on one floor, available total height "H" is measured from the highest drafthood outlet or flue collar up to the level of the cap or terminal. Connector rise "R" is measured from the drafthood outlet or flue collar to the level where the vent gas streams come together. (Not applicable to multi-story).
- 24) For multi-story installations, available total height for each segment of the system "H" is the vertical distance between the highest drafthood outlet or flue collar entering that segment and the centerline of the next higher interconnection tee (See Figure 13).
- 25) The size of the lowest connector and of the vertical vent leading to the lowest interconnection of a multi-story system must be in accordance with Table 1 OR 2, for available total height "H" up to the lowest interconnection (See Figure 14).
- 26) Common vents in multi-story systems shall be type B when used in multi-story systems and have no offsets.
- 27) Numbers followed by an asterisk (\*) in Table 6, indicate the possibility of continuous condensation, depending on locality. Consult appliance manufacturer, local serving gas supplier, and/or authority having jurisdiction.
- 28) In a single run of vent or vent connector, more than one diameter and type of pipe are permitted to be used, provided that all the size are permitted by the tables.
- 29) If the desired vent height and connector rise and/or lateral are between the table entries, linear interpolation is permitted for calculation of the permissible appliance input ratings. Extrapolation beyond the table entries is not recommended. (See Example 7)
- 30) All combinations of pipe sizes, single-wall, and double-wall metal pipe are allowed within any connector run(s) or within the common vent provided ALL of the appropriate tables permit ALL of the desired sizes and types of pipe, as if they were used for the entire length of the subject connector or vent. If single-wall and Type B double-wall metal pipe are used for vent connectors, the common vent must be sized using Table 4.
- 31) Locate draft hood outlet or flue collar of smallest input appliance closest to or under common vent.
- 32) When vent table permits more than one diameter of pipe to be used for a connector or vent, the smallest permitted diameter should be preferred.

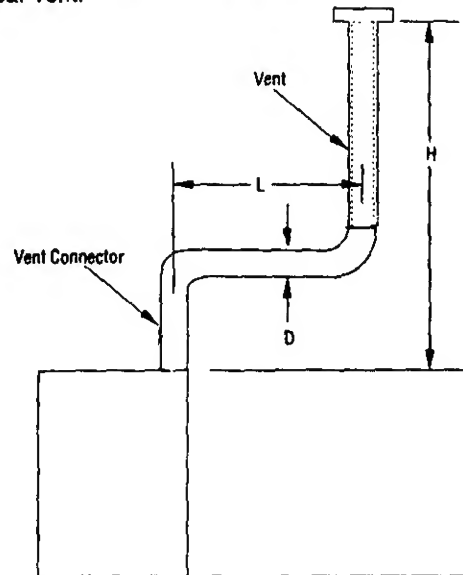
### TYPICAL VENTING APPLICATIONS

**Table 1** should be used when Type B vent is used for both the vent connector and the vertical vent.



**FIGURE 3**

**Table 2** should be used when a single-wall metal vent connector is attached to Type B vertical vent.



**FIGURE 4**



Table 3 should be used when Type B vent connectors are attached to a Type B common vent.

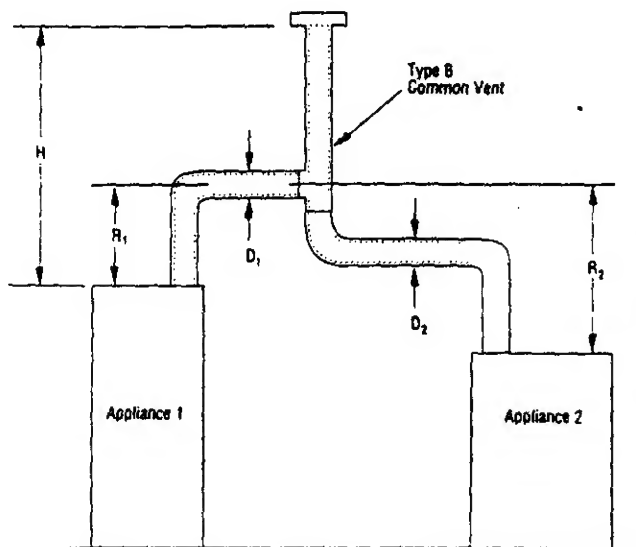


FIGURE 5

Table 4 should be used when single-wall metal vent connectors are attached to a Type B common vent.

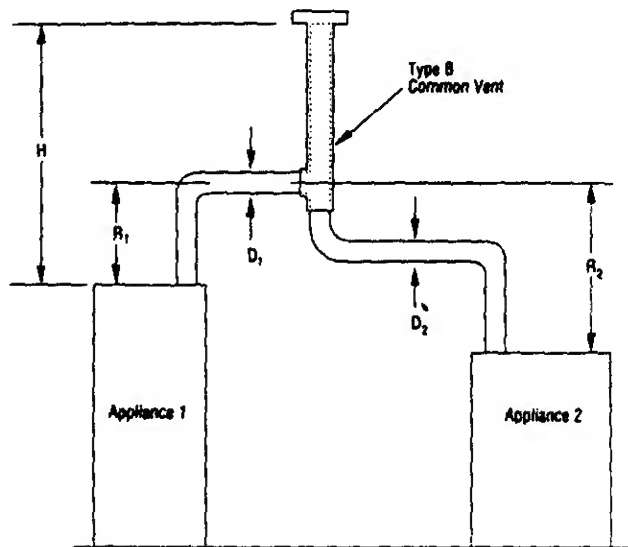


FIGURE 6

Schematic Diagram showing a typical manifolded common vent section "L" of the vent connector. (See Note 5)

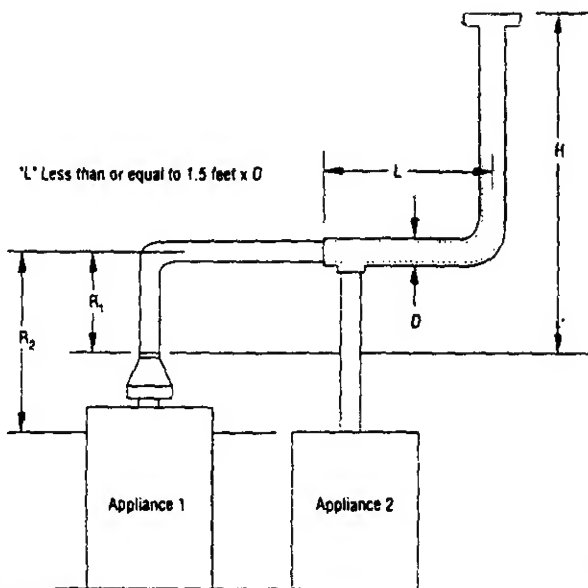


FIGURE 7

Schematic Diagram showing offset in the common vent section of the vertical vent. (See Note 6)

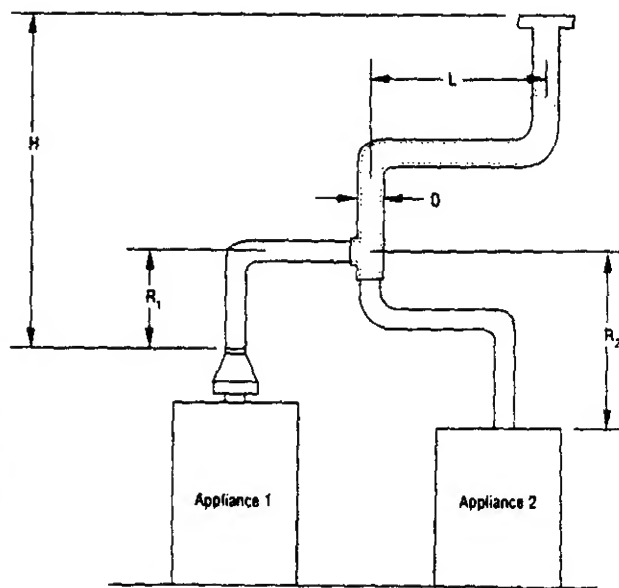
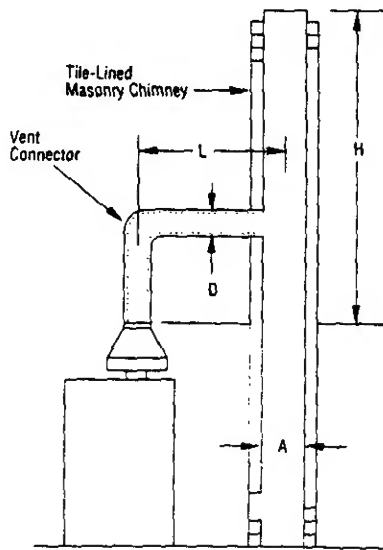


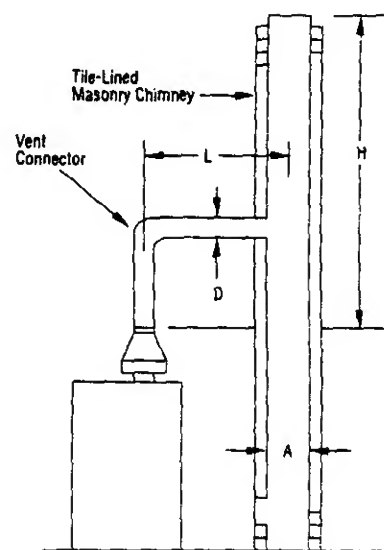
FIGURE 8

**Table 5** shall be used when a Type B, double-wall vent connector is attached to a tile lined masonry chimney.



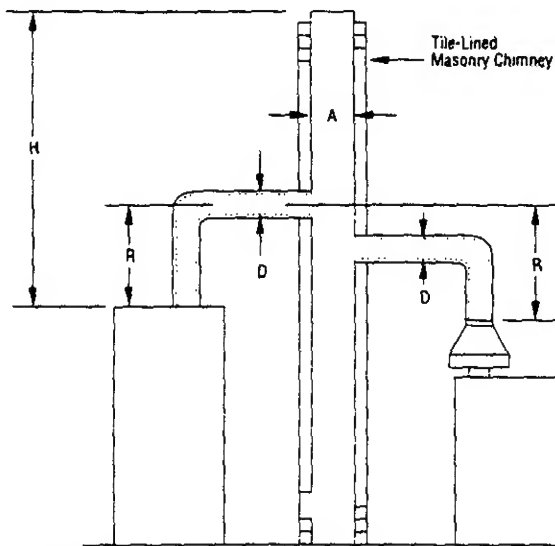
**FIGURE 9**

**Table 6** shall be used when a single-wall metal vent connector is attached to a tile lined masonry chimney.



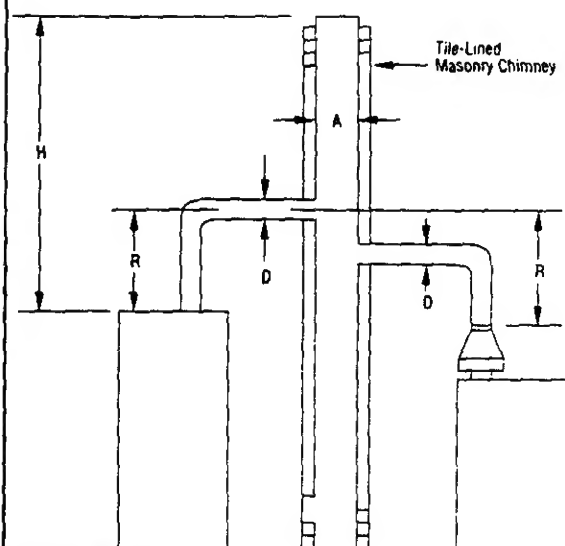
**FIGURE 10**

**Table 7** shall be used when Type B double wall vent connectors are attached to a tile lined masonry chimney.



**FIGURE 11**

**Table 8** shall be used when single-wall metal vent connectors are attached to a tile lined masonry chimney.



**FIGURE 12**

### Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors Serving a Single Category I Appliance

Height H (ft)		Lateral L (ft)		Vent and Connector Diameter - D (inches)																								
				3"		4"		5"		6"		7"		8"		9"												
				Appliance Input Rating in Thousands of Btu Per Hour																								
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT				
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	285	0	698	370	0	897	470						
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	217	53	425	285	63	543	370						
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	211	79	419	279	93	536	362						
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	205	93	413	273	110	530	354						
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320	0	780	415	0	1006	537						
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	247	50	483	322	60	619	418						
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237	83	473	313	99	607	407						
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	227	99	463	303	117	596	396						
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	345	0	847	450	0	1096	585						
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	273	48	533	355	57	684	457						
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	263	81	522	346	95	671	446						
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	245	104	504	330	122	651	427						
15	0	0	94	58	0	191	112	0	327	187	0	502	285	0	716	390	0	970	525	0	1263	682						
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	316	45	633	414	53	815	544						
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	300	76	620	403	90	800	529						
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	288	99	600	386	116	777	507						

# VENT TABLES

Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors  
Serving a Single Category I Appliance

TABLE 1 (Cont'd)

		Vent and Connector Diameter - D (Inches)																													
		10"			12"			14"			16"			18"			20"			22"			24"								
Height H (ft)	Lateral L (ft)	Appliance Input Rating in Thousands of Btu Per Hour																													
		FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max			
6	0	0	1121	570	0	1645	850	0	2267	1170	0	2983	1530	0	3802	1960	0	4721	2430	0	5737	2950	0	6853	3520						
	2	75	675	455	103	982	650	138	1346	890	178	1769	1170	225	2250	1480	296	2782	1850	360	3377	2220	426	4030	2670						
	4	110	668	445	147	975	640	191	1338	880	242	1761	1160	300	2242	1475	390	2774	1835	469	3370	2215	555	4023	2660						
	6	128	661	435	171	967	630	219	1330	870	276	1753	1150	341	2235	1470	437	2767	1820	523	3363	2210	618	4017	2650						
8	0	0	1261	660	0	1858	970	0	2571	1320	0	3399	1740	0	4333	2220	0	5387	2750	0	6555	3360	0	7838	4010						
	2	71	770	515	98	1124	745	130	1543	1020	168	2030	1340	212	2584	1700	278	3196	2110	336	3882	2560	401	4634	3050						
	5	115	758	503	154	1110	733	199	1528	1010	251	2013	1330	311	2563	1685	398	3180	2090	476	3863	2545	562	4612	3040						
	8	137	746	490	180	1097	720	231	1514	1000	289	2000	1320	354	2552	1670	450	3163	2070	537	3850	2530	630	4602	3030						
10	0	0	1377	720	0	2036	1060	0	2825	1450	0	3742	1925	0	4782	2450	0	5955	3050	0	7254	3710	0	8682	4450						
	2	68	852	560	93	1244	850	124	1713	1130	161	2256	1480	202	2868	1890	264	3556	2340	319	4322	2840	378	5153	3390						
	5	112	839	547	149	1229	829	192	1696	1105	243	2238	1461	300	2849	1871	382	3536	2318	458	4301	2818	540	5132	3371						
	10	142	817	525	187	1204	795	238	1669	1080	298	2209	1430	364	2818	1840	459	3504	2280	546	4268	2780	641	5099	3340						
15	0	0	1596	840	0	2380	1240	0	3323	1720	0	4423	2270	0	5678	2900	0	7099	3620	0	8665	4410	0	10393	5300						
	2	63	1019	675	86	1495	985	114	2062	1350	147	2719	1770	186	3467	2260	239	4304	2800	290	5232	3410	346	6251	4080						
	5	105	1003	660	140	1476	967	182	2041	1327	229	2696	1748	283	3442	2235	355	4278	2777	426	5204	3385	501	6222	4057						
	10	135	977	635	177	1446	936	227	2009	1289	283	2659	1712	346	3402	2193	432	4234	2739	510	5159	3343	599	6175	4019						
20	15	155	953	610	202	1418	905	257	1976	1250	318	2623	1675	385	3363	2150	479	4192	2700	564	5115	3300	665	6129	3980						
	0	0	1756	930	0	2637	1350	0	3701	1900	0	4948	2520	0	6376	3250	0	7988	4060	0	9785	4980	0	11753	6000						
	2	59	1150	755	81	1694	1100	107	2343	1520	139	3097	2000	175	3955	2570	220	4916	3200	269	5983	3910	321	7154	4700						
	5	101	1133	738	135	1674	1079	174	2320	1498	219	3071	1978	270	3926	2544	337	4885	3174	403	5950	3880	475	7119	4662						
30	10	130	1105	710	172	1641	1045	220	2282	1460	273	3029	1940	334	3880	2500	413	4835	3130	489	5896	3830	573	7063	4600						
	15	150	1078	688	195	1609	1018	248	2245	1425	306	2988	1910	372	3835	2465	459	4786	3090	541	5844	3795	631	7007	4575						
	20	167	1052	665	217	1578	990	273	2210	1390	335	2948	1880	404	3791	2430	495	4737	3050	585	5792	3760	689	6953	4550						
	30	0	0	1977	1060	0	3004	1550	0	4252	2170	0	5725	2920	0	7420	3770	0	9341	4750	0	11483	5850	0	13848	7060					
50	2	54	1351	865	74	2004	1310	98	2786	1800	127	3696	2380	159	4734	3050	199	5900	3810	241	7194	4650	285	8617	5600						
	5	96	1332	851	127	1981	1289	164	2759	1775	206	3666	2350	252	4701	3020	312	5863	3783	373	7155	4622	439	8574	5552						
	10	125	1301	829	164	1944	1254	209	2716	1733	259	3617	2300	316	4647	2970	386	5803	3739	456	7090	4574	535	8505	5471						
	15	143	1272	807	187	1908	1220	237	2674	1692	292	3570	2250	354	4594	2920	431	5744	3695	507	7026	4527	590	8437	5391						
100	20	160	1243	784	207	1873	1185	260	2633	1650	319	3523	2200	384	4542	2870	467	5686	3650	548	6964	4480	639	8370	5310						
	30	195	1189	745	246	1807	1130	305	2555	1585	369	3433	2130	440	4442	2785	540	5574	3565	635	6842	4375	739	8239	5225						
	0	0	2231	1195	0	3441	1825	0	4934	2550	0	6711	3440	0	8774	4460	0	11129	5635	0	13767	6940	0	16694	8430						
	2	41	1620	1010	66	2431	1513	86	3409	2125	113	4554	2840	141	5864	3670	171	7339	4630	209	8980	5695	251	10788	6860						
200	5	90	1600	996	118	2406	1495	151	3380	2102	191	4520	2813	234	5826	3639	283	7295	4597	336	8933	5654	394	10737	6818						
	10	118	1567	972	154	2366	1466	196	3332	2064	243	4464	2767	295	5763	3585	355	7224	4542	419	8855	5585	491	10652	6749						
	15	136	1536	948	177	2327	1437	222	3285	2026	274	4409	2721	330	5701	3534	396	7155	4511	465	8779	5546	542	10570	6710						
	20	151	1505	924	195	2288	1408	244	3239	1987	300	4356	2675	361	5641	3481	433	7086	4479	506	8704	5506	586	10488	6670						
300	30	183	1446	876	232	2214	1349	287	3150	1910	347	4253	2631	412	5523	3431	494	6953	4421	577	8557	5444	672	10328	6605						
	0	0	2491	1310	0	3925	2050	0	5729	2950	0	7914	4050	0	10485	5300	0	13454	6700	0	16817	8600	0	20578	10300						
	2	30	1975	1170	44	3027	1820	72	4313	2350	95	5834	3500	120	7591	4600	138	9577	5800	169	11803	7200	204	14264	8800						
	5	82	1955	1159	107	3002	1803	136	4282	2531	172	5797	3475	208	7548	4566	245	9528	5769	293	11748	7162	341	14204	8756						
400	10	108	1923	1142	142	2961	1775	180	4231	2500	223	5737	3434	268	7478	4509	318	9447	5717	374	11658	7100	436	14105	8683						
	15	126	1892	1124	163	2920	1747	206	4182	2469	252	5678	3392	304	7409	4451	358	9367	5665	418	11569	7037	487	14007	8610						
	20	141	1861	1107	181	2880	1719	226	4133	2438	277	5619	3351	330	7341	4394	387	9289	5613	452	11482	6975	523	13910	8537						
	30	170	1802	1071	215	2803	1663	265	4037	2375	319	5505	3267	378	7209	4279	446	9136	5509	514	11310	6850	592	13720	8391						
500	50	241	1688	1000	292	2657	1550	350	3856	2250	415	5289	3100	486	6956	4050	572	8841	5300	659	10979	6600	752	13354	8100						

# VENT TABLES

Capacity of Type B Double-Wall Vents with Single-Wall Metal Connectors  
Serving a Single Category I Appliance

TABLE 2

Height H (ft)		Lateral L (ft)		Vent and Connector Diameter - D (Inches)																								
				3"		4"		5"		6"		7"		8"		9"		10"		12"								
				Appliance Input Rating in Thousands of Btu Per Hour																								
				FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max		
6	0	38	77	45	59	151	85	85	249	140	126	373	204	165	522	284	211	695	369	267	894	469	371	1118	569	537	1639	849
	2	39	51	36	60	96	66	85	156	104	123	231	156	159	320	213	201	423	284	251	541	368	347	673	453	498	979	648
	4	NR	NR	33	74	92	63	102	152	102	146	225	152	187	313	208	237	416	277	295	533	360	409	664	443	598	1104	730
	6	NR	NR	31	83	89	60	114	147	99	163	220	148	207	307	203	263	409	271	327	526	352	449	656	433	638	962	627
8	0	37	83	50	58	164	93	83	273	154	123	412	234	161	580	319	206	777	414	258	1002	536	360	1257	658	521	1852	967
	2	39	56	39	59	108	75	83	176	119	121	261	179	155	363	246	197	482	321	246	617	417	339	768	513	486	1120	743
	5	NR	NR	37	77	102	69	107	168	114	151	252	171	193	352	235	245	470	311	305	604	404	418	754	500	598	1104	730
	8	NR	NR	33	90	95	64	122	161	107	175	243	163	223	342	225	280	458	300	344	591	392	470	740	486	665	1089	715
10	0	37	87	53	57	174	99	82	293	165	120	444	254	158	628	344	202	844	449	253	1093	584	351	1373	718	507	2031	1057
	2	39	61	41	59	117	80	82	193	128	119	287	194	153	400	272	193	531	354	242	681	456	332	849	559	475	1242	848
	5	52	56	39	76	111	76	105	185	122	148	277	186	190	388	261	241	518	344	299	667	443	409	834	544	584	1284	825
	10	NR	NR	34	97	100	68	132	171	112	188	261	171	237	369	241	296	497	325	363	643	423	492	808	520	688	1194	788
15	0	36	93	57	56	190	111	80	325	186	116	499	283	153	713	388	195	966	523	244	1259	681	336	1591	838	488	2374	1237
	2	38	69	47	57	136	93	80	225	149	115	337	224	148	473	314	187	631	413	232	812	543	319	1015	673	457	1491	983
	5	51	63	44	75	128	86	102	216	140	144	326	217	182	459	298	231	616	400	287	795	526	392	997	657	562	1469	963
	10	NR	NR	39	95	116	79	128	201	131	182	308	203	228	438	284	284	592	381	349	768	501	470	966	628	664	1433	928
20	0	35	96	60	54	200	118	78	346	201	114	537	306	149	772	428	190	1053	573	238	1379	750	326	1751	927	473	2631	1346
	2	37	74	50	56	148	99	78	248	165	113	375	248	144	528	344	182	708	468	227	914	611	309	1146	754	443	1689	1098
	5	50	68	47	73	140	94	100	239	158	141	363	239	178	514	334	224	692	457	279	896	596	381	1126	734	547	1665	1074
	10	NR	NR	41	93	129	86	125	223	146	177	344	224	222	491	316	277	666	437	339	866	570	457	1092	702	646	1626	1037
30	0	34	99	63	53	211	127	76	372	219	110	584	334	144	849	472	184	1168	647	229	1542	852	312	1971	1056	454	2996	1545
	2	37	80	56	55	164	111	76	281	183	109	429	279	139	610	392	175	823	533	219	1069	698	296	1346	863	424	1999	1308
	5	49	74	52	72	157	106	98	271	173	136	417	271	171	595	382	215	806	521	269	1049	684	366	1324	846	524	1971	1283
	10	NR	NR	NR	91	144	98	122	255	168	171	397	257	213	570	367	265	777	501	327	1017	662	440	1287	821	620	1927	1243
50	0	33	99	66	51	213	133	73	394	230	105	629	361	138	928	515	176	1292	704	220	1724	948	295	2223	1189	428	3432	1818
	2	36	84	61	53	181	121	73	318	205	104	495	312	133	712	443	168	971	613	209	1273	811	280	1615	1007	401	2426	1509
	5	48	80	NR	70	174	117	94	308	198	131	482	305	164	696	435	204	953	602	257	1252	795	347	1591	991	496	2396	1490
	10	NR	NR	NR	89	160	NR	118	292	186	162	461	292	203	671	420	253	923	583	313	1217	765	418	1551	963	589	2347	1455
100	0	NR	NR	NR	112	148	NR	145	275	174	199	441	280	244	646	405	299	894	562	363	1183	736	481	1512	934	668	2299	1421
	2	NR	NR	NR	NR	NR	NR	176	257	NR	236	420	267	285	622	389	345	866	543	415	1150	708	544	1473	906	741	2251	1387
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	10	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
300	0	NR	NR	NR	49	214	NR	69	403	NR	100	659	395	131	991	555	166	1404	765	207	1900	1033	273	2479	1300	395	3912	2042
	2	NR	NR	NR	51	192	NR	70	351	NR	98	563	373	125	828	508	158	1152	698	196	1532	933	259	1970	1168	371	3021	1817
	5	NR	NR	NR	67	186	NR	90	342	NR	125	551	366	156	813	501	194	1134	688	240	1511	921	322	1945	1153	460	2990	1796
	10	NR	NR	NR	85	175	NR	113	324	NR	153	532	354	191	789	486	238	1104	672	293	1477	902	389	1905	1133	547	2938	1763
500	0	NR	NR	NR	132	162	NR	138	310	NR	188	511	343	230	764	473	281	1075	656	342	1443	884	447	1865	1110	618	2888	1730
	2	NR	NR	NR	NR	NR	NR	168	295	NR	224	487	NR	270	739	458	325	1046	639	391	1410	864	507	1825	1087	690	2838	1696
	5	NR	NR	NR	NR	NR	NR	231	264	NR	301	448	NR	355	685	NR	418	988	NR	491	1343	824	631	1747	1041	834	2739	1627
	10	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	540	584	NR	617	866	NR	711	1205	NR	895	1591	NR

# **VENT TABLES**

**Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors  
Serving Two or more Category I Appliances**

**TABLE 3**

**Vent Connector Capacity**

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D (Inches)																							
				3"		4"		5"		6"		7"		8"		9"		10"									
				Appliance Input Rating Limits in Thousands of Btu Per Hour																							
				FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
Min		Max	Max	Min		Max	Max	Min		Max	Max	Min		Max	Max	Min		Max	Max	Min		Max	Max	Min		Max	Max
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142	92	296	185	109	376	237	128	466	289		
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168	95	333	220	112	424	282	131	526	345		
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189	97	363	248	114	463	317	134	575	386		
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148	100	320	194	118	408	248	138	507	303		
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175	103	356	230	121	454	294	141	564	358		
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198	105	384	258	123	492	330	143	612	402		
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154	106	341	200	125	436	257	146	542	314		
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182	109	374	238	128	479	305	149	596	372		
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205	111	402	268	131	515	342	152	642	417		
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163	110	389	214	134	493	273	162	609	333		
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193	112	419	253	137	532	323	165	658	394		
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218	115	445	286	140	565	365	167	700	444		
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171	107	436	224	131	552	285	158	681	347		
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202	110	463	265	134	587	339	161	725	414		
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228	113	486	300	137	618	518	164	764	466		
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391	182	103	512	238	125	649	305	151	802	372		
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215	105	535	282	129	679	360	155	840	439		
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242	108	555	317	132	706	405	158	874	494		
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477	197	97	627	257	120	797	330	144	984	403		
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490	234	100	645	306	123	820	392	148	1014	478		
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502	263	103	661	343	126	842	441	151	1043	538		
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611	204	91	810	266	112	1038	341	135	1285	417		
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619	242	94	822	316	115	1054	405	139	1306	494		
	3	20	84	50	31	163	89	44	272	138	57	452	200	78	627	272	97	834	355	118	1069	455	142	1327	555		

**Common Vent Capacity**

Vent Height H (ft)	Common Vent Diameter - D (Inches)																				
	4"			5"			6"			7"			8"			9"			10"		
	Combined Appliance Input Rating in Thousands of Btu Per Hour																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	92	81	65	140	116	103	204	161	147	309	248	200	404	314	260	547	434	335	672	520	410
8	101	90	73	155	129	114	224	178	163	339	275	223	444	348	290	602	480	378	740	577	465
10	110	97	79	169	141	124	243	194	178	367	299	242	477	377	315	649	522	405	800	627	495
15	125	112	91	195	164	144	283	228	206	427	352	280	556	444	365	753	612	465	924	733	565
20	136	123	102	215	183	160	314	255	229	475	394	310	621	499	405	842	688	523	1035	826	640
30	152	138	118	244	210	185	361	297	266	547	459	360	720	585	470	979	808	605	1209	975	740
50	167	153	134	279	244	214	421	353	310	641	547	423	854	706	550	1164	977	705	1451	1188	860
100	175	163	NR	311	277	NR	489	421	NR	751	658	479	1025	873	625	1408	1215	800	1784	1502	975



## VENT TABLES

**TABLE 3 (cont'd)**

**Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors  
Serving two or more Category I Appliances**

**Vent Connector Capacity**

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D (inches)																				
				12"			14"			16"			18"			20"			22"			24"		
				Appliance Input Rating Limits in Thousands of Btu Per Hour																				
				FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
Min		Max	Max	Min		Max	Max	Min		Max	Max	Min		Max	Max	Min		Max	Max	Min		Max	Max	
6	2	174	764	496	223	1046	653	281	1371	853	346	1772	1080	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	180	897	616	230	1231	827	287	1617	1081	352	2069	1370	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
8	2	186	822	516	238	1126	696	298	1478	910	365	1920	1150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	192	952	644	244	1307	884	305	1719	1150	372	2211	1460	471	2737	1800	560	3319	2180	662	3957	2590		
	6	198	1050	772	252	1445	1072	313	1902	1390	380	2434	1770	478	3018	2180	568	3665	2640	669	4373	3130		
10	2	196	870	536	249	1195	730	311	1570	955	379	2049	1205	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	201	997	664	256	1371	924	318	1804	1205	387	2332	1535	486	2887	1890	581	3502	2280	686	4175	2710		
	6	207	1095	792	263	1509	1118	325	1989	1455	395	2556	1865	494	3169	2290	589	3849	2760	694	4593	3270		
15	2	214	967	568	272	1334	790	336	1760	1030	408	2317	1305	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	221	1085	712	279	1499	1006	344	1978	1320	416	2579	1665	523	3197	2060	624	3881	2490	734	4631	2960		
	6	228	1181	856	286	1632	1222	351	2157	1610	424	2796	2025	533	3470	2510	634	4216	3030	743	5035	3600		
20	2	223	1051	596	291	1443	840	357	1911	1095	430	2533	1385	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	230	1162	748	298	1597	1064	365	2116	1395	438	2778	1765	554	3447	2180	661	4190	2630	772	5005	3130		
	6	237	1253	900	307	1726	1288	373	2287	1695	450	2984	2145	567	3708	2650	671	4511	3190	785	5392	3790		
30	2	216	1217	632	286	1664	910	367	2183	1190	461	2891	1540	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	223	1316	792	294	1802	1160	376	2366	1510	474	3110	1920	619	3840	2365	728	4681	2860	847	5606	3410		
	6	231	1400	952	303	1920	1410	384	2524	1830	485	3299	2340	632	4080	2875	741	4976	3480	860	5961	4150		
50	2	206	1479	689	273	2023	1007	350	2659	1315	435	3548	1665	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	213	1561	860	281	2139	1291	359	2814	1685	447	3730	2135	580	4601	2633	709	5569	3185	851	6633	3790		
	6	221	1631	1031	290	2242	1575	369	2951	2055	461	3893	2605	594	4808	3208	724	5826	3885	867	6943	4620		
100	2	192	1923	712	254	2644	1050	326	3490	1370	402	4707	1740	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	4	200	1984	888	263	2731	1346	336	3606	1760	414	4842	2220	523	5982	2750	639	7254	3330	769	8650	3950		
	6	208	2035	1064	272	2811	1642	346	3714	2150	426	4968	2700	539	6143	3350	654	7453	4070	786	8892	4810		

**Common Vent Capacity**

Vent Height H (ft)	Common Vent Diameter - D (inches)																				
	12"			14"			16"			18"			20"			22"			24"		
	Combined Appliance Input Rating in Thousands of Btu Per Hour																				
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT
6	900	696	588	1284	990	815	1735	1336	1065	2253	1732	1345	2838	2180	1660	3488	2677	1970	4206	3226	2390
8	994	773	652	1423	1103	912	1927	1491	1190	2507	1936	1510	3162	2439	1860	3890	2998	2200	4695	3616	2680
10	1076	841	712	1542	1200	995	2093	1625	1300	2727	2113	1645	3444	2665	2030	4241	3278	2400	5123	3957	2920
15	1247	986	825	1794	1410	1158	2440	1910	1510	3184	2484	1910	4026	3133	2360	4971	3862	2790	6016	4670	3400
20	1405	1116	916	2006	1588	1290	2722	2147	1690	3561	2798	2140	4548	3552	2640	5573	4352	3120	6749	5261	3800
30	1658	1327	1025	2373	1892	1525	3220	2558	1990	4197	3326	2520	5303	4193	3110	6539	5157	3680	7940	6247	4480
50	2024	1640	1280	2911	2347	1863	3964	3183	2430	5184	4149	3075	6567	5240	3800	8116	6458	4500	9837	7813	5475
100	2569	2131	1670	3732	3076	2450	5125	4202	3200	6749	5509	4050	8597	6986	5000	10681	8648	5920	13004	10499	7200

## VENT TABLES

Capacity of Type B Double-Wall Vent with Single-Wall Connectors  
Serving Two or more Category I Appliances

**TABLE 4**

**Vent Connector Capacity**

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D (Inches)																															
				3"			4"			5"			6"			7"			8"			9"			10"										
				Appliance Input Rating Limits in Thousands of Btu Per Hour																															
				FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT				
Min			Max			Min			Max			Min			Max			Min			Max			Min			Max			Min			Max		
6	1	NR	NR	26	NR	NR	46	NR	NR	71	NR	NR	102	207	223	140	262	293	183	325	373	234	447	463	286										
	2	NR	NR	31	NR	NR	55	NR	NR	85	168	182	123	215	251	167	271	331	219	334	422	281	458	524	344										
	3	NR	NR	34	NR	NR	62	121	131	95	174	198	138	222	273	188	279	361	247	344	462	316	468	574	385										
15	1	NR	NR	29	79	87	52	116	138	81	177	214	116	238	291	158	312	380	208	397	482	266	556	596	324										
	2	NR	NR	34	83	94	62	121	150	97	185	230	138	246	314	189	321	411	248	407	522	317	568	646	387										
	3	NR	NR	39	87	100	70	127	160	109	193	243	157	255	333	215	331	438	281	418	557	360	579	690	437										
30	1	47	60	31	77	110	57	113	175	89	169	278	129	226	380	175	296	497	230	378	630	294	528	779	358										
	2	50	62	37	81	115	67	117	185	106	177	290	152	236	397	208	307	521	274	389	662	349	541	819	425										
	3	54	64	42	85	119	76	122	193	120	185	300	172	244	412	235	316	542	309	400	690	394	555	855	482										
50	1	46	69	33	75	128	60	109	207	96	162	336	137	217	460	188	284	604	245	364	768	314	507	951	384										
	2	49	71	40	79	132	72	114	215	113	170	345	164	226	473	223	294	623	293	376	793	375	520	983	458										
	3	53	72	45	83	136	82	119	221	128	178	353	186	235	486	252	304	640	331	387	816	424	535	1013	518										

**Common Vent Capacity**

Vent Height H (ft)	Common Vent Diameter - D (inches)																							
	4"			5"			6"			7"			8"			9"			10"					
	Combined Appliance Input Rating in Thousands of Btu Per Hour																							
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT			
6	89	78	64	136	113	100	200	158	144	304	244	196	398	310	257	541	429	332	665	515	407			
8	98	87	71	151	126	112	218	173	159	331	269	218	436	342	285	592	473	373	730	569	460			
10	106	94	76	163	137	120	237	189	174	357	292	236	467	369	309	638	512	398	787	617	487			
15	121	108	88	189	159	140	275	221	200	416	343	274	544	434	357	738	599	456	905	718	553			
20	131	118	98	208	177	155	305	247	223	463	383	302	606	487	395	824	673	512	1013	808	626			
30	145	132	113	236	202	179	350	286	257	533	446	349	703	570	459	958	790	593	1183	952	723			
50	159	145	128	268	233	204	406	337	296	622	529	410	833	686	535	1139	954	689	1418	1157	838			

# VENT TABLES

Capacity of Masonry Chimney with Type B Double-Wall Vent Connectors  
Serving a Single Category I Appliance

TABLE 5

Height H (ft)		Connector Diameter - D (Inches)												To be used with chimney areas within the size limits at bottom											
		Appliance Input Rating in Thousands of Btu Per Hour																							
		3"		4"		5"		6"		7"		8"		9"		10"		12"							
Lateral L (ft)	FAN	NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
6	2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
10	2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
15	2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
20	2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
30	2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
50	2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Minimum Internal Area of Chimney Square Inches		12		19		28		38		50		63		78		95		132							
Maximum Internal Area of Chimney Square Inches		49		88		137		198		269		352		445		550		792							

# VENT TABLES

Capacity of Masonry Chimney with Single-Wall Vent Connectors  
Serving a Single Category I Appliance

TABLE 6

Height H (ft)		Lateral L (ft)		Connector Diameter - D (Inches)												To be used with chimney areas within the size limits at bottom													
				Appliance Input Rating in Thousands of Btu Per Hour																									
				3"		4"		5"		6"		7"		8"		9"		10"		12"									
FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT			
Min		Max		Min		Max		Min		Max		Min		Max		Min		Max		Min		Max		Min		Max			
6	2	NR	NR	28	NR	NR	NR	52	NR	NR	NR	86	NR	NR	NR	180	NR	NR	247	NR	NR	NR	319	NR	NR	400	NR	NR	580
	5	NR	NR	25*	NR	NR	NR	48	NR	NR	NR	81	NR	NR	NR	164	NR	NR	230	NR	NR	NR	297	NR	NR	375	NR	NR	560
10	2	NR	NR	31	NR	NR	NR	61	NR	NR	NR	102	NR	NR	NR	220	NR	NR	297	NR	NR	NR	387	NR	NR	490	NR	NR	722
	5	NR	NR	28*	NR	NR	NR	56	NR	NR	NR	95	NR	NR	NR	203	NR	NR	276	NR	NR	NR	364	NR	NR	465	NR	NR	710
	10	NR	NR	24*	NR	NR	NR	49*	NR	NR	NR	86	NR	NR	NR	189	NR	NR	261	NR	NR	NR	345	NR	NR	441	NR	NR	665
15	2	NR	NR	35*	NR	NR	NR	67	NR	NR	NR	113	NR	NR	NR	249	NR	NR	335	NR	NR	NR	440	NR	NR	560	NR	NR	840
	5	NR	NR	32*	NR	NR	NR	61	NR	NR	NR	106	NR	NR	NR	230	NR	NR	312	NR	NR	NR	414	NR	NR	531	NR	NR	825
	10	NR	NR	27*	NR	NR	NR	54*	NR	NR	NR	96	NR	NR	NR	214	NR	NR	294	NR	NR	NR	392	NR	NR	504	NR	NR	774
20	15	NR	NR	NR	NR	NR	NR	46*	NR	NR	NR	87*	NR	NR	NR	198	NR	NR	278	NR	NR	NR	372	NR	NR	481	NR	NR	738
30	2	NR	NR	38*	NR	NR	NR	73	NR	NR	NR	123	NR	NR	NR	273	NR	NR	374	NR	NR	NR	490	NR	NR	625	NR	NR	950
	5	NR	NR	35*	NR	NR	NR	67*	NR	NR	NR	115	NR	NR	NR	252	NR	NR	348	NR	NR	NR	461	NR	NR	594	NR	NR	930
	10	NR	NR	NR	NR	NR	NR	59*	NR	NR	NR	105*	NR	NR	NR	235	NR	NR	330	NR	NR	NR	437	NR	NR	562	NR	NR	875
50	15	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	95*	NR	NR	NR	217	NR	NR	311	NR	NR	NR	414	NR	NR	536	NR	NR	835
	20	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	80*	NR	NR	NR	202	NR	NR	292	NR	NR	NR	392	NR	NR	510	NR	NR	800
30	2	NR	NR	41*	NR	NR	NR	81*	NR	NR	NR	136	NR	NR	NR	302	NR	NR	420	NR	NR	NR	556	NR	NR	715	NR	NR	1110
	5	NR	NR	NR	NR	NR	NR	75*	NR	NR	NR	127*	NR	NR	NR	279	NR	NR	391	NR	NR	NR	524	NR	NR	680	NR	NR	1090
	10	NR	NR	NR	NR	NR	NR	66*	NR	NR	NR	113*	NR	NR	NR	260	NR	NR	370	NR	NR	NR	496	NR	NR	644	NR	NR	1020
30	15	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	105*	NR	NR	NR	240*	NR	NR	349	NR	NR	NR	471	NR	NR	615	NR	NR	975
	20	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	88*	NR	NR	NR	223*	NR	NR	327	NR	NR	NR	445	NR	NR	585	NR	NR	932
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	182*	NR	NR	281*	NR	NR	NR	408	NR	NR	544	NR	NR	865
30	2	NR	NR	NR	NR	NR	NR	91*	NR	NR	NR	160*	NR	NR	NR	350*	NR	NR	475	NR	NR	NR	631	NR	NR	810	NR	NR	1240
	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	149*	NR	NR	NR	321*	NR	NR	442	NR	NR	NR	593	NR	NR	770	NR	NR	1220
	10	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	136*	NR	NR	NR	301*	NR	NR	420*	NR	NR	NR	562	NR	NR	728	NR	NR	1140
30	15	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	124*	NR	NR	NR	278*	NR	NR	395*	NR	NR	NR	533*	NR	NR	695	NR	NR	1090
	20	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	258*	NR	NR	370*	NR	NR	NR	504*	NR	NR	660*	NR	NR	1040
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	318*	NR	NR	NR	458*	NR	NR	610*	NR	NR	970
Minimum Internal Area of Chimney Square Inches				12		19		28		38		50		63		78		95		132									
Maximum Internal Area of Chimney Square Inches				49		88		137		198		269		352		445		550		792									

\* SEE NOTE 27

## VENT TABLES

Capacity of Masonry Chimney with Type B Double-Wall Connectors  
Serving two or more Category I Appliances

**TABLE 7**

**Vent Connector Capacity**

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D (inches)																									
				3"			4"			5"			6"			7"			8"			9"			10"				
				Appliance Input Rating Limits in Thousands of Btu Per Hour																									
				FAN			NAT			FAN			NAT			FAN			NAT			FAN			NAT			FAN	
Min Max Max			Min Max Max			Min Max Max			Min Max Max			Min Max Max			Min Max Max			Min Max Max			Min Max Max			Min Max Max			Min Max Max		
6	1	24	NR	21	39	62	40	52	106	67	65	194	101	87	274	141	104	370	201	124	479	253	145	599	319				
	2	26	43	28	41	79	52	53	133	85	67	230	124	89	324	173	107	436	232	127	562	330	148	694	378				
	3	27	49	34	42	92	61	55	155	97	69	262	143	91	369	203	109	491	270	129	633	349	151	795	439				
15	1	24	48	23	38	93	44	54	154	74	72	277	114	100	384	174	125	511	229	153	658	297	184	824	375				
	2	25	55	31	39	105	55	56	174	89	74	299	134	103	419	192	128	558	260	156	718	339	187	900	432				
	3	26	59	35	41	115	64	57	189	102	76	319	153	105	448	215	131	597	292	159	760	382	190	960	486				
30	1	24	54	25	37	111	48	52	192	82	69	357	127	96	504	187	119	680	255	145	883	337	175	1115	432				
	2	25	60	32	38	122	58	54	208	95	72	376	145	99	531	209	122	715	287	149	928	378	179	1171	484				
	3	26	64	36	40	131	66	56	221	107	74	392	163	101	554	233	125	746	317	152	968	418	182	1220	535				
50	1	23	52	26	36	116	49	51	209	82	67	405	133	92	582	198	115	798	271	140	1049	362	168	1334	462				
	2	24	59	31	37	127	58	53	225	96	70	421	152	95	604	222	118	827	304	143	1085	400	172	1379	510				
	3	26	64	37	39	135	66	55	237	108	72	435	170	98	624	247	121	854	334	147	1118	439	176	1421	558				

**Common Vent Capacity**

Vent Height H (ft)	Minimum Internal Area of Chimney, Square Inches																							
	12			19			28			38			50			63			78			113		
	Combined Appliance Input Rating in Thousands of Btu Per Hour																							
	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT	FAN	FAN	NAT
	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT
6	NR	74	23	NR	119	46	NR	178	71	NR	257	103	NR	351	143	NR	458	188	NR	582	246	NR	853	NR
8	NR	80	28	NR	130	53	NR	193	82	NR	279	119	NR	384	163	NR	501	218	NR	636	278	NR	937	408
10	NR	84	31	NR	138	56	NR	207	90	NR	299	131	NR	409	177	NR	538	236	NR	686	302	NR	1010	454
15	NR	90	36	NR	152	67	NR	233	106	NR	334	152	NR	467	212	NR	611	283	NR	781	365	NR	1156	546
20	NR	92	41	NR	159	75	NR	250	122	NR	368	172	NR	508	243	NR	668	325	NR	858	419	NR	1286	648
30	NR	NR	NR	NR	NR	NR	NR	270	137	NR	404	198	NR	564	278	NR	747	381	NR	969	496	NR	1473	749
50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	620	328	NR	831	461	NR	1089	606	NR	1692	922

## VENT TABLES

### Capacity of Masonry Chimney with Single-Wall Connectors Serving two or more Category I Appliances

**TABLE 8**

**Vent Connector Capacity**

Vent Height H (ft)		Connector Rise R (ft)		Vent Connector Diameter - D (Inches)																							
				3"			4"			5"			6"			7"			8"			9"			10"		
				Appliance Input Rating Limits in Thousands of Btu Per Hour																							
				FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	
6	1	NR	NR	21	NR	NR	39	NR	NR	66	179	191	100	231	271	140	292	366	200	362	474	252	499	594	283		
	2	NR	NR	28	NR	NR	52	NR	NR	84	186	227	123	239	321	172	301	432	231	373	557	299	509	696	331		
	3	NR	NR	34	NR	NR	61	134	153	97	193	258	142	247	365	202	309	491	269	381	634	348	519	793	375		
15	1	NR	NR	23	NR	NR	43	129	151	73	199	271	112	268	376	171	349	502	225	445	646	291	623	808	360		
	2	NR	NR	30	92	103	54	135	170	88	207	295	132	277	411	189	359	548	256	456	706	334	634	884	402		
	3	NR	NR	34	96	112	63	141	185	101	215	315	151	286	439	213	368	586	289	466	755	378	646	945	437		
30	1	NR	NR	24	86	108	47	126	187	80	193	347	124	259	492	183	338	665	250	430	864	330	600	1089	455		
	2	NR	NR	31	91	119	57	132	203	93	201	366	142	269	518	205	348	699	282	442	908	372	613	1145	490		
	3	NR	NR	35	95	127	65	138	216	105	209	381	160	277	540	229	358	729	312	452	946	412	626	1193	521		
50	1	NR	NR	25	85	113	48	124	204	80	188	392	130	252	567	194	328	778	265	417	1022	355	582	1302	537		
	2	NR	NR	31	89	123	57	130	218	94	196	408	149	262	588	218	339	806	298	429	1058	393	596	1346	567		
	3	NR	NR	35	94	131	65	136	231	106	205	422	167	271	607	243	349	831	328	440	1090	431	610	1386	595		

**Common Vent Capacity**

Vent Height H (ft)	Minimum Internal Area of Chimney, Square Inches																							
	12			19			28		38		50		63		78		113							
	Combined Appliance Input Rating in Thousands of Btu Per Hour																							
	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT	FAN +FAN	FAN +NAT	NAT +NAT						
6	NR	73	25	NR	118	45	NR	176	71	NR	255	102	NR	348	142	NR	455	187	NR	579	245	NR	846	NR
8	NR	79	28	NR	128	52	NR	190	81	NR	276	118	NR	380	162	NR	497	217	NR	633	277	NR	928	405
10	NR	83	31	NR	136	56	NR	205	89	NR	295	129	NR	405	175	NR	532	234	NR	680	300	NR	1000	450
15	NR	88	36	NR	149	66	NR	230	105	NR	335	150	NR	460	210	NR	602	280	NR	772	360	NR	1139	540
20	NR	90	40	NR	157	74	NR	247	120	NR	362	170	NR	503	240	NR	661	321	NR	849	415	NR	1264	640
30	NR	NR	NR	NR	NR	NR	NR	266	135	NR	398	195	NR	558	275	NR	739	377	NR	957	490	NR	1447	740
50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	612	325	NR	821	456	NR	1076	600	NR	1672	910



TABLE 9

**MASONRY CHIMNEY LINER DIMENSIONS  
WITH CIRCULAR EQUIVALENTS**

NOMINAL LINER SIZE INCHES	INSIDE DIMENSIONS IN LINER INCHES	INSIDE DIA. OR EQUIVALENT DIA. INCHES	EQUIVALENT AREA SQ. INCHES
4 x 8	2 1/2 x 6 1/2	4	12.2
		5	19.6
		6	28.3
		7	38.3
8 x 8	6 3/4 x 6 3/4	7.4	42.7
		8	50.3
8 x 12	6 1/2 x 10 1/2	9	63.6
		10	78.5
12 x 12	9 3/4 x 9 3/4	10.4	83.3
		11	95
12 x 16	9 1/2 x 13 1/2	11.8	107.5
		12	113
		14	153.9
16 x 16	13 1/4 x 13 1/4	14.5	162.9
		15	176.7
16 x 20	13 x 17	16.2	206.1
		18	254.4
20 x 20	16 3/4 x 16 3/4	18.2	260.2
		20	314.1
20 x 24	16 1/2 x 20 1/2	20.1	314.2
		22	380.1
24 x 24	20 1/4 x 20 1/4	22.1	380.1
		24	452.3
24 x 28	20 1/2 x 24 1/4	24.1	456.2
28 x 28	24 1/4 x 24 1/4	26.4	543.3
		27	572.5
30 x 30	25 1/2 x 25 1/2	27.9	607
		30	706.8
30 x 36	25 1/2 x 31 1/2	30.9	749.9
		33	855.3
36 x 36	31 1/2 x 31 1/2	34.4	929.4
		36	1017.9

When liner sizes differ dimensionally from those shown in Table 9 equivalent diameters may be determined from published tables for square and rectangular ducts of equivalent carrying capacity or by other engineering methods.

## EXAMPLES USING SINGLE APPLIANCE VENTING TABLES

### Example 1: Single Draft-Hood-Equipped Appliance

Suppose that an installer has a 120,000 Btu/hr input appliance with a 5 inch diameter draft hood outlet that needs to be vented into a 10 foot high Type B vent system. What size vent should be used assuming (a) a 5-Ft lateral single-wall metal vent connector is used with two 90° elbows, (b) a 5-Ft lateral single-wall metal vent connector is used with three 90° elbows in the vent system?

#### Solution

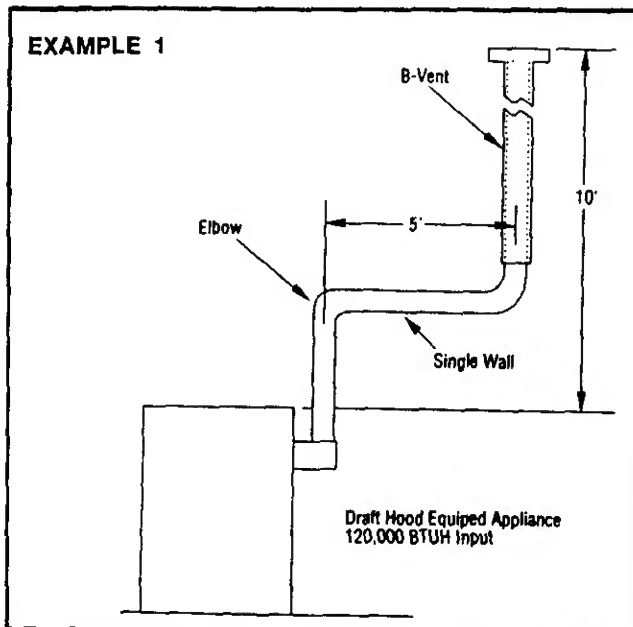
Table 2 should be used to solve this problem because single-wall metal vent connectors are being used with a Type B vent. Refer to Figure 4 of Typical Applications.

- (a) Read down the first column in Table 2 until the row associated with a 10-Ft height and 5-Ft lateral is found. Read across this row until a vent capacity greater than 120,000 Btu/hr is located in the shaded columns labeled "NAT Max" for draft-hood-equipped appliances. In this case, a 5 inch diameter vent has a capacity of 122,000 Btu/hr and may be used for this application.
- (b) If three 90° elbows are used in the vent system, then the maximum vent capacity listed in the tables must be reduced by 10 percent (see Note 3). This implies that the 5 inch diameter vent has an adjusted capacity of only 110,000 Btu/hr. In this case, the vent system must be increased to 6 inches in diameter. See calculations below:

$$122,000 \times .90 = 110,000 \text{ for 5" Vent}$$

From Table 2 - Select 6" Vent

$186,000 \times .90 = 167,000$ ; This is greater than the required 120,000, therefore use a 6" Vent and connector when three elbows are used.



### Example 2: Single Fan-Assisted Appliance

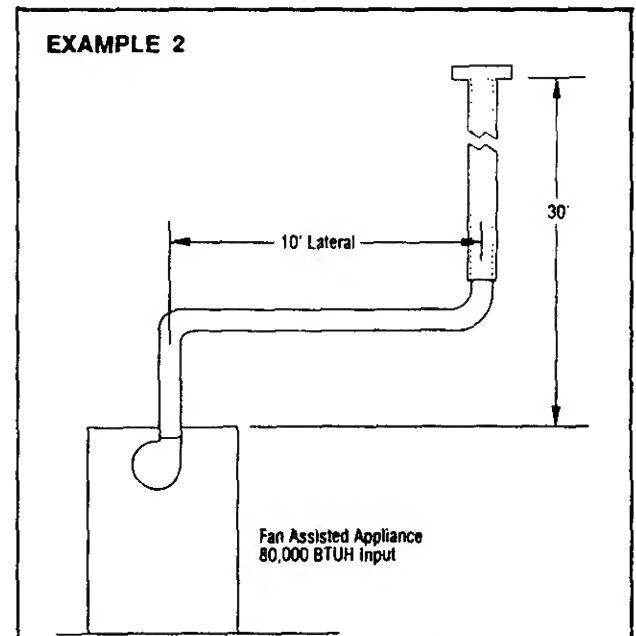
Suppose an installer has an 80,000 Btu/hr input fan-assisted appliance that must be installed using 10 feet of lateral connector attached to a 30-Ft high Type B vent. Two 90° elbows are needed for the installation. Can a single-wall metal vent connector be used for this application?

#### Solution

Table 2 refers to the use of single-wall metal vent connectors with Type B vent. In the first column find the row associated with a 30-Ft height and a 10-Ft lateral. Read across this row, looking at the "FAN Min" and "FAN Max" columns, to find that a 3 inch diameter single-wall metal connector vent is not recommended. Moving to the next larger size single wall connector (4") we find that a 4 inch diameter single-wall metal connector has a recommended minimum vent capacity of 91,000 Btu/hr and a recommended maximum vent capacity of 144,000 Btu/hr. The 80,000 Btu/hr fan-assisted appliance is outside this range, so we conclude that a single-wall metal vent connector cannot be used to vent this appliance using 10 feet of lateral for the connector.

However, we see that if the 80,000 Btu/hr input appliance could be moved to within 5 feet of the vertical vent, then a 4 inch single-wall metal connector could be used to vent the appliance. Table 2 shows the acceptable range of vent capacities for a 4 inch vent with 5 feet of lateral to be between 72,000 Btu/hr and 157,000 Btu/hr.

If the appliance cannot be moved closer to the vertical vent, then Type B vent could be used as the connector material. In this case, Table 1 shows that for a 30-Ft high vent with 10 feet of lateral, the acceptable range of vent capacities for a 4 inch diameter vent attached to a fan-assisted appliance are between 37,000 Btu/hr and 150,000 Btu/hr.



## EXAMPLES USING COMMON VENTING TABLES

### Example 3: Common Venting Two Draft-Hood Appliances

Suppose a 35,000 Btu/hr water heater is to be common vented with a 150,000 Btu/hr furnace using a common vent with a total height of 30 feet. The connector rise is 2 feet for the water heater and 3 feet for the furnace. Assume single-wall metal connectors will be used with Type B vent. What size connectors and combined vent should be used in this installation?

**Solution -** (Table 4 applies in this example)

Table 4 should be used to size single-wall metal vent connectors attached to Type B vertical vent. In the vent connector capacity Table 4, find the row associated with a 30-Ft vent height. For a 2-Ft rise on the vent connector for the water heater, read the shaded columns for draft-hood-equipped appliances to find that a 3 inch diameter vent connector has a capacity of 37,000 Btu/hr.

Therefore, a 3 inch single-wall metal vent connector may be used with the water heater. For a draft-hood-equipped furnace with a 3-Ft rise, read across the appropriate row to find that a 5 inch diameter vent connector has a maximum capacity of 120,000 Btu/hr (which is too small for the furnace) and a 6 inch diameter vent connector has a maximum vent capacity of 172,000 Btu/hr. Therefore, a 6 inch diameter vent connector should be used with the 150,000 Btu/hr furnace.

For the capacity of the combined vent, the lower portion of Table 4 should be used. The combined vent capacity required is 185,000 Btu/hr. Table 4 shows that the combined vent capacity of a 6 inch diameter vent with a 30-Ft vent height is 257,000 Btu/hr. This is more than adequate to handle the 35,000 Btu/hr input water heater and the 150,000 Btu/hr input furnace.

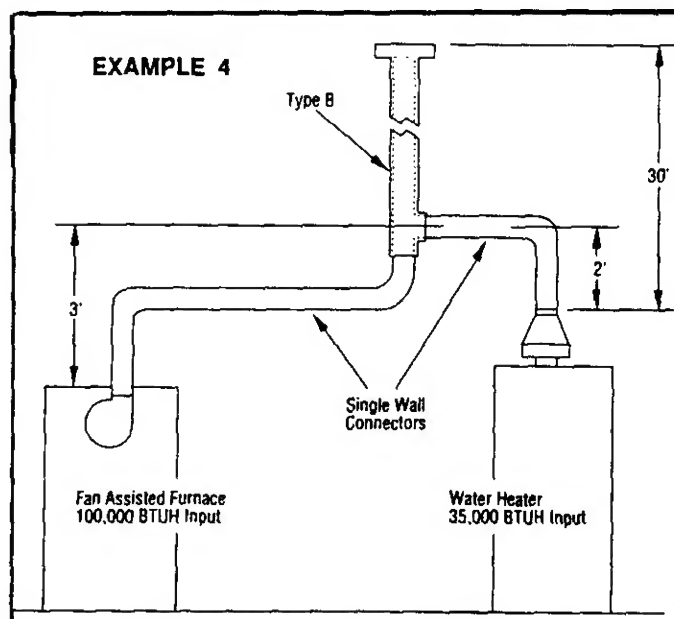
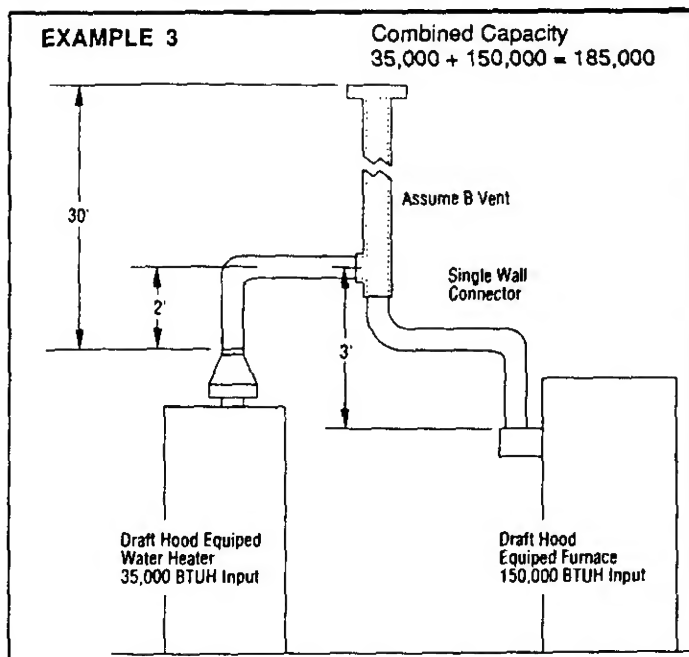
### Example 4: Common Venting a Draft Hood Water Heater with a Fan-Assisted Furnace

In this case, a 35,000 Btu/hr input draft-hood-equipped water heater with a 2 foot connector rise is to be common vented with a 100,000 Btu/hr fan-assisted furnace with a 3-Ft connector rise. The common vent consists of a 30-Ft rise of Type B vent. What are the recommended vent diameters for each connector and the common vent?

**Solution -** (Table 4)

**Water Heater Vent Connector Diameter.** Let us assume the installer would like to use a single-wall metal vent connector. Using Table 4, Vent Connector Capacity, read down the Total Vent Height "H" column to 30 feet and read across the 2-Ft Connector Rise "R" row to the first Btu/hr rating in the "NAT Max" column that is equal to or greater than the water heater input rating. The table shows that a 3 inch vent connector has a maximum input rating of 37,000 Btu/hr. Since this is greater than the water heater input rating, a 3 inch vent connector is adequate. Furthermore, since the water heater is equipped with a draft hood, there are no minimum input rating restrictions.

**Furnace Vent Connector Diameter.** Again, let us assume the installer would like to use a single-wall metal vent connector. Using Table 4, Vent Connector Capacity, read down the Total Vent Height "H" column to 30 feet and across the 3-ft Connector Rise "R" row. Since the furnace has a fan-assisted combustion system, find the first "FAN Max" column with a Btu/hr rating greater than the furnace input rating. The 4 inch vent connector has a maximum input rating of 119,000 Btu/hr and a minimum input rating of 85,000 Btu/hr. The 100,000 Btu/hr furnace in this example falls within this range, so a 4 inch connector is adequate. If the furnace would have had an input rating of 80,000 Btu/hr, then a Type B vent connector (see Table 4) would have to be used in order to meet the minimum capacity limit.



## EXAMPLES USING COMMON VENTING TABLES

### Example 4: (cont'd)

**Common Vent Diameter.** The total input to the common vent is 135,000 Btu/hr. Using Table 4, Common Vent Capacity, read down the Total Vent Height "H" column to 30 feet and across this row to find the smallest vent diameter in the "FAN+NAT" column that has a Btu/hr rating equal to or greater than 135,000 Btu/hr. The 4 inch common vent has a capacity of 132,000 Btu/hr and the 5 inch common vent has a capacity of 202,000 Btu/hr. Therefore, the 5 inch common vent should be used in this example.

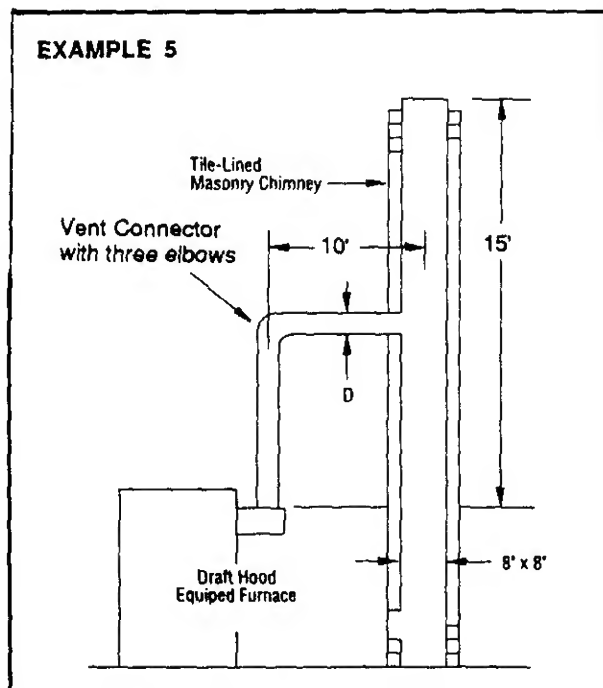
**Summary.** In this example, the installer may use a 3 inch diameter, single-wall metal vent connector for the water heater and a 4 inch diameter, single-wall metal vent connector for the furnace. The common vent should be a 5 inch diameter Type B vent.

### Example 5: Single Draft Hood Equipped Furnace Vented into A Masonry Chimney

A 135,000 Btu/hr draft hood equipped furnace is to be vented into a 15' high tile lined masonry chimney. The chimney is not exposed to the outside except above the roof line. The furnace has a 6" diameter draft hood outlet and requires a 10' lateral vent connector with 3 elbows. The chimney is constructed using a 8" x 8" liner. What size single wall vent connector is required?

#### Solution:

Table 6 should be used. Refer to the figure for Example 5.



To determine the required vent connector diameter, read down the height column in Table 6 until 15' is found. Find the row for a 10' long lateral. The table shows that a 6" diameter connector will allow a maximum capacity of 151,000 Btu/hr for "Nat Max." (draft-hood equipped) furnace. Because 3 elbows are required, however, the maximum capacity must be reduced by 10% (See Note 3). Allowing for the additional elbow the corrected maximum capacity is 135,900 Btu/hr. A 6" diameter connector is large enough and should be used. The internal area of the chimney is 8" x 8" = 64 sq. in. and is within the acceptable range (38 sq. in. to 198 sq. in.) for a 6" vent connector as shown in Table 6.

### Example 6: Common venting into a Masonry Chimney

In this case, a 35,000 Btu/hr input 4 inch diameter outlet draft hood-equipped water heater with 2 feet of connector rise and 4 feet of horizontal length is to be common vented with a 100,000 Btu/hr fan-assisted furnace with a 4 inch diameter flue collar, 3 feet of connector rise and 6 feet of horizontal length. The common vent is an 8 x 12 tile lined chimney that is 30 feet tall. What are the recommended vent diameters for each connector? Is this an acceptable installation?

#### Solution

Table 8 is used to size common venting installations involving single wall connectors into masonry chimneys.

**Water Heater Vent Connector Diameter.** Using Table 8, Vent Connector Capacity, read down the Total Vent Height "H" column to 30 feet and read across the 2 ft Connector Rise "R" row to the first Btu/hr rating in the "NAT MAX" column that is equal to or greater than the water heater input rating. The Table shows that a 3 inch vent connector has a maximum input of only 31,000 Btu/hr while a 4 inch vent connector has a maximum input of 57,000 Btu/hr. A 4 inch vent connector must therefore be used.

**Furnace Vent Connector Diameter.** Using Table 8 Vent Connector Capacity, read down the Total Vent Height "H" column to 30 feet and across the 3 ft Connector Rise "R" row. Since the furnace has a fan-assisted combustion system, find the first "FAN MAX" column with a Btu/hr rating greater than the furnace input rating. The 4 inch vent connector has a maximum input rating of 127,000 Btu/hr and a minimum input rating of 95,000 Btu/hr. The 100,000 Btu/hr furnace in this example falls within this range, so a 4 inch connector is adequate.

#### EXAMPLE 6: (cont'd)

**Masonry Chimney.** From Table 9, the Equivalent Area for a Nominal Liner size of 8 inches x 12 inches is 63.6 square inches. Using Table 8, Common Vent Capacity, read down the "Fan + Nat" column under the Minimum internal Area of Chimney value of 63 to the row for 30-ft height, to find a capacity value of 739,000 Btu/hr. The combined input rating of the furnace and water heater 135,000 Btu/hr, is less than the Table value, so this is an acceptable installation.

*Note 19 requires the common vent area to be no greater than seven times the flow area of the smallest appliance outlet area. Both appliances in this installation use 4 inch diameter outlets. From Table 9, the Equivalent Area for an Inside Diameter of 4 inches is 12.2 square inches. Seven times 12.2 is 85.4, which is greater than 63.6, so this configuration is acceptable.*

*Note 1 specifies that the Table values are for vents or chimneys which are not exposed to the outdoors below the roofline. If the masonry chimney in this case were exposed below the roofline, then the appliance manufacturer, local gas utility, and/or authority having jurisdiction must be consulted.*

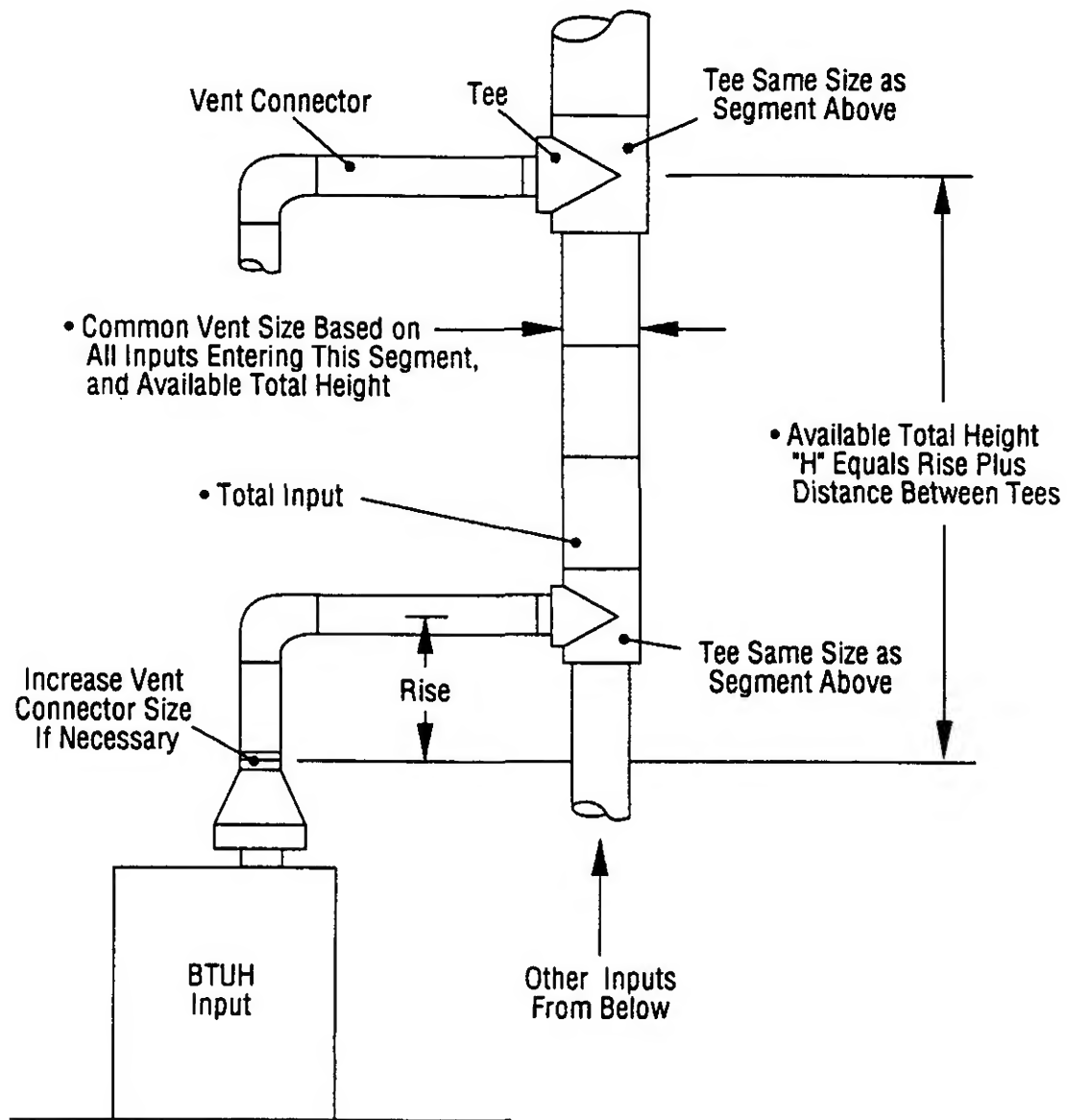
#### Example 7: Interpolating Between Table Values

An installer has an 80,000 Btu/hr input appliance with a 4 inch diameter draft hood outlet that needs to be vented into a 12-ft high Type B vent. The vent connector has a 5 ft lateral length and is also Type B. Can this appliance be vented using a 4 inch diameter vent?

#### Solution

Table 1 is used in the case of an all Type B vent system. However, since there is no entry in Table 1 for height of 12 feet, interpolation must be used. Read down the 4 inch diameter "NAT Max" column to the row associated with 10 ft. height and 5 ft. lateral to find the capacity value of 77,000 Btu/hr. Go down further to the 15 ft. height, 5 ft. lateral row to find the capacity value of 87,000 Btu/hr. The difference between the 15 ft. height capacity value and the 10 ft. height capacity value is 10,000 Btu/hr. The capacity for a vent system with a 12 ft. height is equal to the capacity for a 10 ft. height plus  $2/5$  of the difference between the 10 ft. and 15 ft. height values, or  $77,000 + 2/5 \times 10,000 = 81,000$  Btu/hr. Therefore, a 4 inch diameter vent may be used in the installation.

# Multi-story Gas Vent Design Procedure for Each Segment of System



Vent Connector Size Depends On:

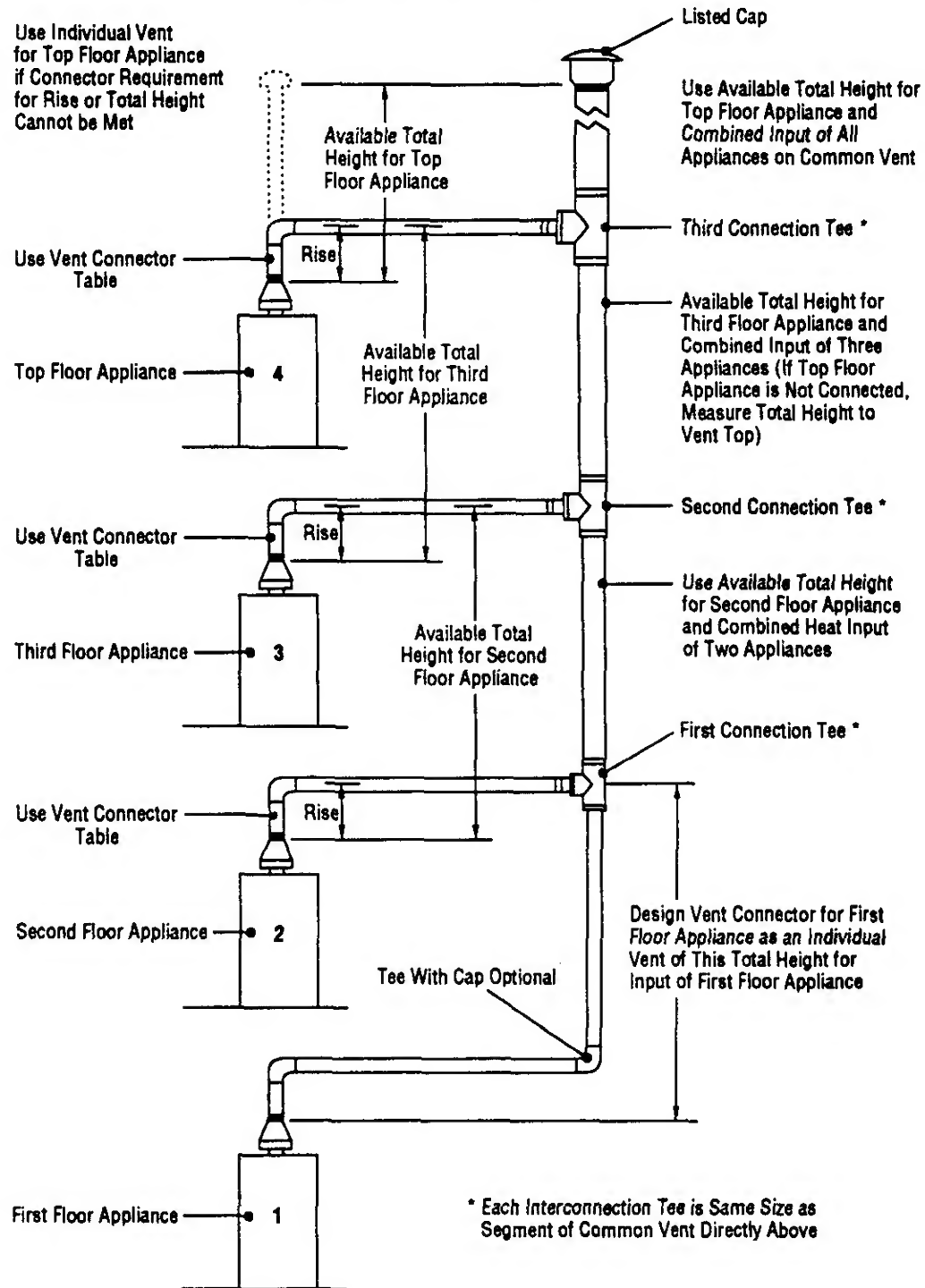
- Input
- Rise
- Available Total Height "H"
- Table 3 Connectors

Common Vent Size Depends On:

- Combined Inputs
- Available Total Height "H"
- Table 3 Common Vent
- Vertical Common Vent With No Offsets

**Figure 13**

## Multi-story Vent Systems



Principles of Design of Multi-story Vents Using Vent Connector and Common Vent Design Tables

**Figure 14**





**NOTES:**



To assure both safe and proper operation, please carefully follow the instructions in this Addendum and the basic Installers' Information Manual, number 404200, supplied with this furnace, to install this new furnace.

**ATTENTION, INSTALLER!** After installing furnace, give the user:

- Users' Information Manual; —Parts List
- Installers' Information Manual and this Addendum; —Warranty Information

**ATTENTION, USER!** Your furnace installer should give you four important documents relating to your furnace. Keep these as long as you keep your furnace. Pass these documents on to later furnace purchasers or users. If any of the four documents is missing or damaged, contact your installer or furnace manufacturer for replacement. For efficient service, please give your furnace model and serial number, listed in Section 1 of your Users' Information Manual. Throughout this Installers' Information Manual Addendum, we frequently use the word "you" when referring to the person responsible for application, installation and service of your furnace. Please remember to have only qualified service technicians perform these services.

**WARNING:** INDIVIDUALS WHO INSTALL THIS FURNACE, MUST HAVE THE TRAINING AND EXPERIENCE NECESSARY TO INSTALL HORIZONTAL GAS FURNACES. THEY MUST ALSO HAVE TRAINING AND EXPERIENCE NECESSARY TO INSTALL RELATED COMFORT AIR CONDITIONING APPLIANCES. IMPROPER INSTALLATION COULD CREATE A HAZARD, RESULTING IN DAMAGE, INJURY OR DEATH.

While we have written these instructions as accurately and thoroughly as possible, they may not cover every system variation or contingency. Also, questions or interpretation may arise. For more information, solutions to particular problems or clarification contact your local distributor. See the furnace rating plate for who to contact.

Furnace installation must follow all applicable NATIONAL, STATE and LOCAL CODES.

**WARNING:** FOR YOUR SAFETY, WHAT TO DO IF YOU SMELL GAS.

- DO NOT TRY TO LIGHT ANY APPLIANCE;
- DO NOT TOUCH ANY ELECTRICAL SWITCH; DO NOT USE ANY PHONE IN THE BUILDING;
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE;
- FOLLOW GAS SUPPLIERS INSTRUCTIONS;
- IF YOU CANNOT REACH GAS SUPPLIER, CALL FIRE DEPARTMENT.

**IMPORTANT SAFETY NOTE:** After installing the furnace, show the user how to turn off gas and electricity to furnace. Point out control and switch locations for turning off gas and electricity. Go over Section 6 of Users' Information Manual and Section 31 of the Installers' Information Manual with user. Warn user to keep insulating materials away from furnace and combustion and ventilation air openings into furnace space. Explain to user that these openings provide fresh air to furnace, that is necessary for proper operation. Make sure user understands the importance of following all safety precautions.

## 1. HORIZONTAL VENTING

**NOTE:** This Induced Draft furnaces can be horizontally vented through an outside wall without the addition of an accessory power venter. Horizontally vented Induced Draft furnaces **must not** be common vented with any other appliance.

**WARNING: COMMON VENTING COULD ALLOW PRODUCTS OF COMBUSTION TO ESCAPE THROUGH OTHER APPLIANCE CONNECTED TO SAME VENT. THIS COULD RESULT IN COMBUSTION PRODUCTS COLLECTING IN STRUCTURE DURING USE, RESULTING IN INJURY OR DEATH.**

### A. Venting Materials

Use only high temperature plastic pipe for horizontal venting of induced draft furnaces. Allowable materials are Hart & Cooley's "Ultravent" or Plexco's "Plexvent". Install using these instructions and vent manufacturers' instructions.

**WARNING: DO NOT USE DOUBLE WALL B-VENT, SINGLE WALL C-VENT, PVC OR ANY OTHER PLASTIC VENTING MATERIALS OTHER THAN THOSE LISTED BELOW. IMPROPER VENTING MATERIALS COULD DETERIORATE ALLOWING COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE DURING USE, RESULTING IN INJURY OR DEATH.**

### VENT COMPONENTS

Item Description	Hart/Cooley 3" Pipe	Plexco 3" Pipe	Plexco 4" Pipe
5 ft. Pipe Length	3UP5	901220	903851
90-Degree Sweep Elbow	3UES90	902299	905772
45-Degree Elbow	3UE45	903958	905773
Tee	3UT	905268	903854
Debris Screen	3UDS	—	—
Tee With Screen	—	901971	906882
Condensate Drain	3UDP	906646	903855
Coupling	3UC	905630	905807
4" Reducer	4UR3	905744	905744
Sealant	DOW736RTV	DOW736RTV	DOW736RTV
Drain Tee-Lateral	3UT	901761	903929
Drain Tee-Vertical	3UT	901467	903917
Wall Thimble	Note (1)	Note (1)	Note (2)
Roof Flashing	3UF	Note (3)	Note (4)
Vent Outlet Kit	—	—	4059400*

(1) Use 905295, 905662, or 906972 (2) Use 906979, 907084, 907094 or 907103

(3) Use 905650, 906971, 905337 (4) Use 907078, 906983, 907089 or 907105

\* This kit is supplied by manufacturer and is only required on models with inputs of 120,000 or 140,000 BTUH.

## B. Planning The Installation

AIR SPACE CLEARANCES TO COMBUSTIBLE MATERIAL	
Pipe Diameter	Clearance
3"	5"
4"	9"

\* Clearances to combustible material may be reduced when combustible material is protected as described in current National Fuel Gas Code ANSI Z223.1/NFPA54, part 6 entitled "Installation of Specific Equipment", subsection entitled "Clearances for Indoor Installation".

**NOTE:** When high temperature plastic pipe is used on a furnace converted to downflow position, be aware that plastic pipe must be disconnected each time service or certain replacement parts are needed. When replacing plastic pipe after servicing or repair, follow pipe joining instructions to assure a proper seal.

**NOTE:** Do not insulate high temperature plastic pipe or fittings.

- Maintain clearances listed above to all sections of pipe, except at wall thimble when horizontally venting.
- Tools needed for installation are: Hacksaw - 24 teeth per inch, Level, Foil Tape, Hammer and Nails, Masonry Saw, Support Strapping and Tape Measure.
- Before installing vent system, be sure you have enough space to attain the required 1/4 inch rise per foot of vent run. This rise is necessary for proper vent operation and condensate drainage.
  - Support vent every 5 feet horizontally and at all elbows or couplings.
- Locate vent wall penetration so that it allows a minimum of 1/4 inch rise per foot of vent run.
- Locate vent termination so prevailing winds will not affect its operation. When this is not possible, consider using protection from strong winds such as a fence.
  - Locate vent termination following the minimum clearances listed below and see Figure 1.
    - At least 12 inches above grade level or above normal snow accumulation level.
    - At least 4 feet below, 4 feet horizontally from or 1 foot above any door, window or gravity air inlet to the building.
    - At least 4 feet horizontally from and not above any public walkways, regulators, relief valves or gas and electric meters.

4. At least 6 feet from any inside corner formed by two exterior walls. 10 feet is desirable.
5. At least 4 feet horizontally and vertically from any soffit or under eave vent.
6. At least 3 feet above or 10 feet from any forced air inlet to the building.
7. At least 10 feet from any adjacent building.
8. At least 4 feet from plants or shrubbery.

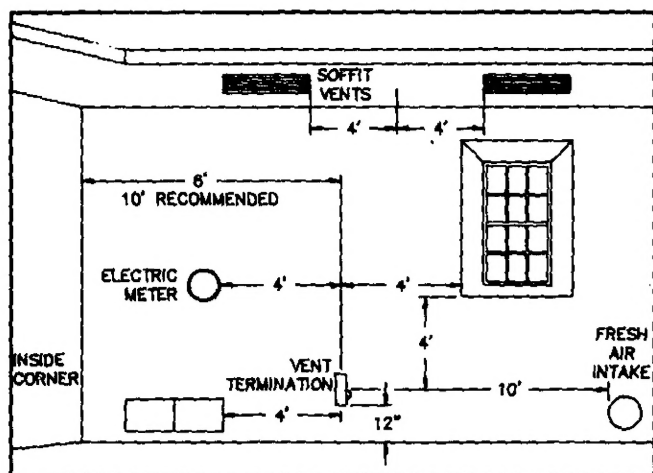


Figure 1

6. See below for allowable vent lengths and vent pipe sizes.

#### Furnace

Input BTUH	Vent Pipe Size	Maximum Lengths & Elbows
40,000	3 inch	40 ft. & 4 elbows
60,000	4 inch	40 ft. & 4 elbows
80,000	4 inch	40 ft. & 4 elbows
100,000	4 inch	40 ft. & 4 elbows
120,000	4 inch	40 ft. & 4 elbows
140,000	4 inch	40 ft. & 4 elbows

**NOTE:** A minimum vent length of 48 inches is necessary for furnace service access.

### C. Vent Pipe Installation

#### 1. Cutting

Cut pipe with a handsaw containing at least 24 teeth per inch. Cut pipe squarely.

**WARNING:** FAILURE TO CUT PIPE SQUARELY COULD RESULT IN PIPE NOT SEALING PROPERLY. THIS COULD ALLOW

**COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE DURING USE, RESULTING IN INJURY OR DEATH.**

**WARNING:** DO NOT DRILL HOLES IN PLASTIC PIPE OR FITTINGS. DO NOT USE SHEET METAL SCREWS, RIVETS OR LOCKING CLIPS IN PIPE OR FITTINGS. DRILLING, USING SCREWS OR RIVETS MAY CAUSE PIPE OR FITTINGS TO CRACK, ALLOWING COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE DURING USE, RESULTING IN INJURY OR DEATH.

**NOTE:** Do not cut pipe with a power saw. Cutting pipe with a power saw may cause cracking or shattering of pipe. Cracking or shattering pipe may prevent a complete seal when joining pipe.

#### 2. Joining and Sealant

Use only approved sealant, Dow-Corning RTV-736.

**WARNING:** USE ONLY APPROVED SEALANT, DO NOT USE PVC CEMENT. FAILURE TO SEAL VENT SYSTEM WITH PROPER SEALANT AND PROCEDURE COULD ALLOW COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE DURING USE, RESULTING IN INJURY OR DEATH.

**NOTE:** Be sure pipe and fitting surfaces are clean and free of any oils, greases or dirt that could adversely affect the pipe seal.

- a. Apply a 1/4 inch thick bead of approved sealant within 1/8 inch of male pipe end. Apply entirely around outside of male pipe.
- b. Push pipe and fitting completely together in a twisting motion to help spread sealant.
- c. When pipe seats in the fitting, check that a complete ring of sealant is visible. A complete ring of sealant assures seal is gas-tight. Sealant cures in 24 hours. Use foil tape to hold joints together until cured, remove tape after sealant cures.

**NOTE:** Vent system can be used before sealant cures.

#### 3. Vent Outlet Kit (4059400)

You must use vent outlet kit part number 4059400 when using high temperature plastic pipe on models with inputs of 120,000 and 140,000 Btuh. Vent outlet kit 4059400 is only required on models with inputs of 120,000 and 140,000 Btuh.

Vent outlet kit is required to convert oval vent collar to round vent collar. Round vent collar will make furnace compatible for use with 4 inch diameter, high temperature plastic pipe.

#### 4. Condensate Disposal

Vent system must contain a tee with drain plug and means of disposing of condensate. The drain tee must be within the first 18 inches of vent run to prevent furnace condensate and rain from draining back into furnace.

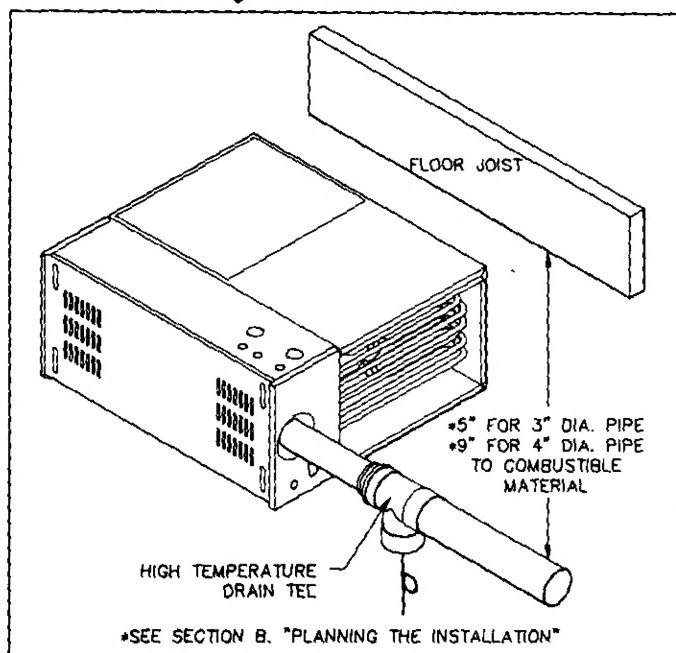


Figure 2

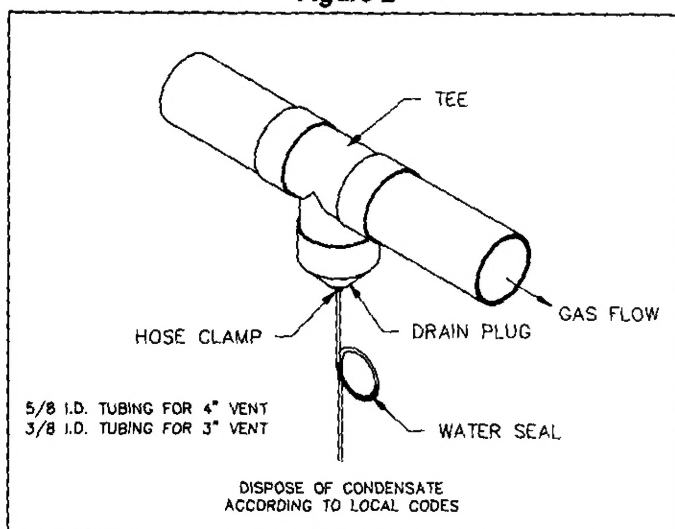


Figure 3

Attach correct size flexible vinyl drain tubing to drain plug. Fill the drain tube trap with a water seal. This will prevent combustion products from escaping through the flexible vinyl drain tube. See Figure 3.

**WARNING:** FAILURE TO FILL FLEXIBLE VINYL DRAIN TUBE TRAP WITH A WATER SEAL COULD ALLOW COMBUSTION PRODUCTS TO COLLECT IN STRUCTURE DURING USE, RESULTING IN INJURY OR DEATH.

**NOTE:** If flexible vinyl drain tube is in an area that may expose condensate to below freezing temperatures, use heat tapes. Use heat tapes that will not melt condensate tubing material.

#### 5. Wall Penetration

- a. When penetrating a non-combustible wall, make the hole just large enough for vent pipe. Use approved sealant material to seal vent pipe to the non-combustible wall. See Figure 4.

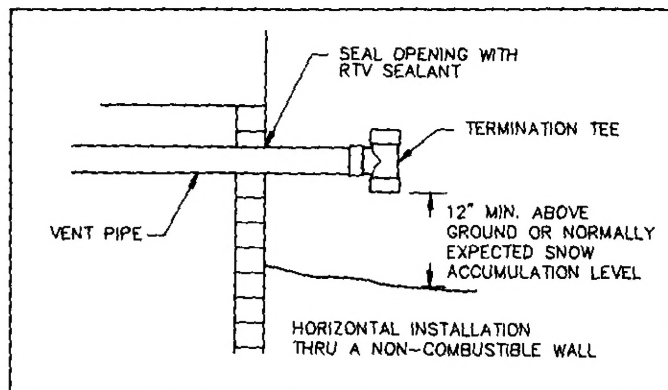


Figure 4

- b. When penetrating a combustible wall, you must use a listed wall thimble. All thimbles are adjustable to fit variable wall thicknesses and are listed in the parts list on page 2.

**WARNING:** FAILURE TO USE A WALL THIMBLE COULD CAUSE COMBUSTIBLE WALL MATERIAL TO IGNITE RESULTING IN DAMAGE, INJURY OR DEATH.

**NOTE:** Use Figure 5 in conjunction with instructions below to properly install wall thimble.

1. Cut an 8 1/2 inch diameter round hole in wall. Locate it where you can maintain the necessary 1/4 inch per foot rise in the vent system.
2. Hold thimble in place by applying approved sealant to male half before assembling. Insert thimble into wall.
3. After inserting thimble, secure to outside and inside walls with nails or screws. Seal thimble to inner and outer walls with approved sealant material.
4. Insert a section of vent pipe through thimble that leaves at least 14 inches of vent pipe protruding from thimble.
5. To prevent vent pipe from moving in thimble, attach stainless steel hose clamp to both pipe ends extending from thimble. See Figure 5.

## D. Vent Termination Tee Installation

Use only a termination tee with debris screen for vent termination. See below for allowable termination tees.

Item Description	Hart/Cooley 3" Pipe	Plexco 3" Pipe	Plexco 4" Pipe
Termination Tee	3UT	—	—
Debris Screen	3UDS	—	—
Termination Tee with Debris Screen	—	901971	906882

**Caution:** Do not locate the vent termination closer than 4 feet to plants or shrubbery as combustion products may stunt or kill them. Also see section B for proper vent termination tee clearances.

**Caution:** In some instances, excessive condensate at the termination tee can cause staining or damage to the outside wall. Sealing or shielding of outside wall with a corrosion resistant material (such as aluminum sheet) may be necessary.

### 1. Installing Termination Tee

- Use approved sealant to join termination tee to section of vent pipe protruding from thimble. Termination tee must be in vertical position. See Figure 5.
- Make sure debris screens are in place.
- The inside of the termination tee must be a minimum of 14 inches from outside wall. See Figure 5 for a correctly completed installation.

**Caution:** Do not step on, sit or place any weight on termination tee. If termination tee is dislodged, furnace may not operate.

**WARNING:** DO NOT STEP ON, HIT OR PLACE ANY WEIGHT ON TERMINATION TEE. IF TERMINATION TEE IS MISHANDLED, VENT SYSTEM MAY BECOME DISCONNECTED AT FURNACE ALLOWING FLUE PRODUCTS TO COLLECT IN STRUCTURE DURING USE, RESULTING IN INJURY OR DEATH.

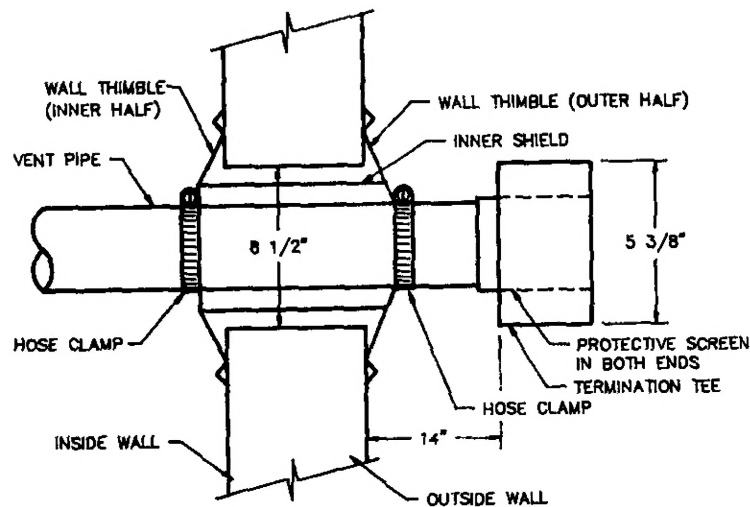
## 2. VERTICAL VENTING

When using high temperature plastic pipe, vent system must be dedicated and is not to be common vented with any other appliance.

**WARNING:** COMMON VENTING COULD ALLOW PRODUCTS OF COMBUSTION TO ESCAPE THROUGH OTHER APPLIANCE CONNECTED TO SAME VENT. THIS COULD RESULT IN COMBUSTION PRODUCTS COLLECTING IN STRUCTURE DURING USE, RESULTING IN INJURY OR DEATH.

### A. Starting Vent System

You may use high temperature plastic pipe to vertically vent this induced-draft furnace. Use instructions in horizontal venting section for proper air space clearances to combustible materials, pipe sizing, allowable runs, joining, cutting, condensate disposal, inducer transition, and plastic vent transition kit. See Figures 6 and 7 for correctly started vertical vent systems.



3" and 4" Thimble

Figure 6  
67

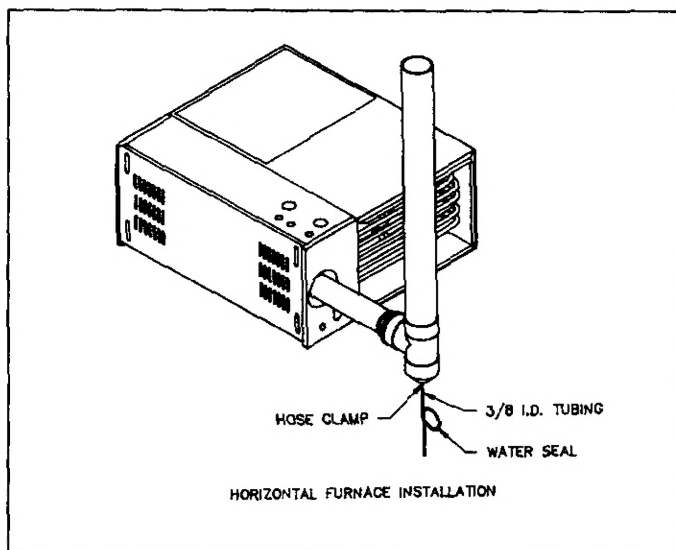


Figure 6

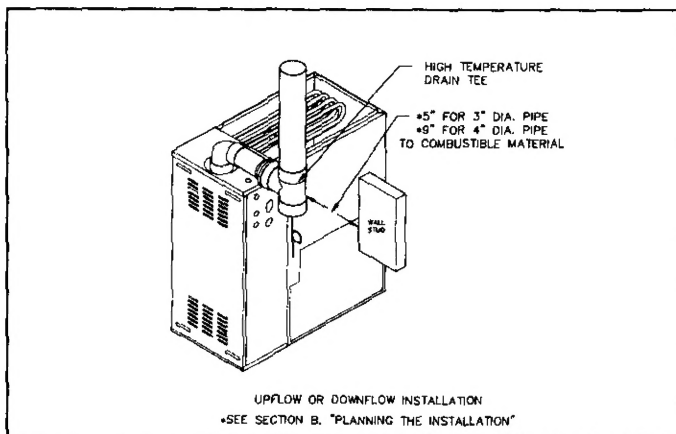


Figure 7

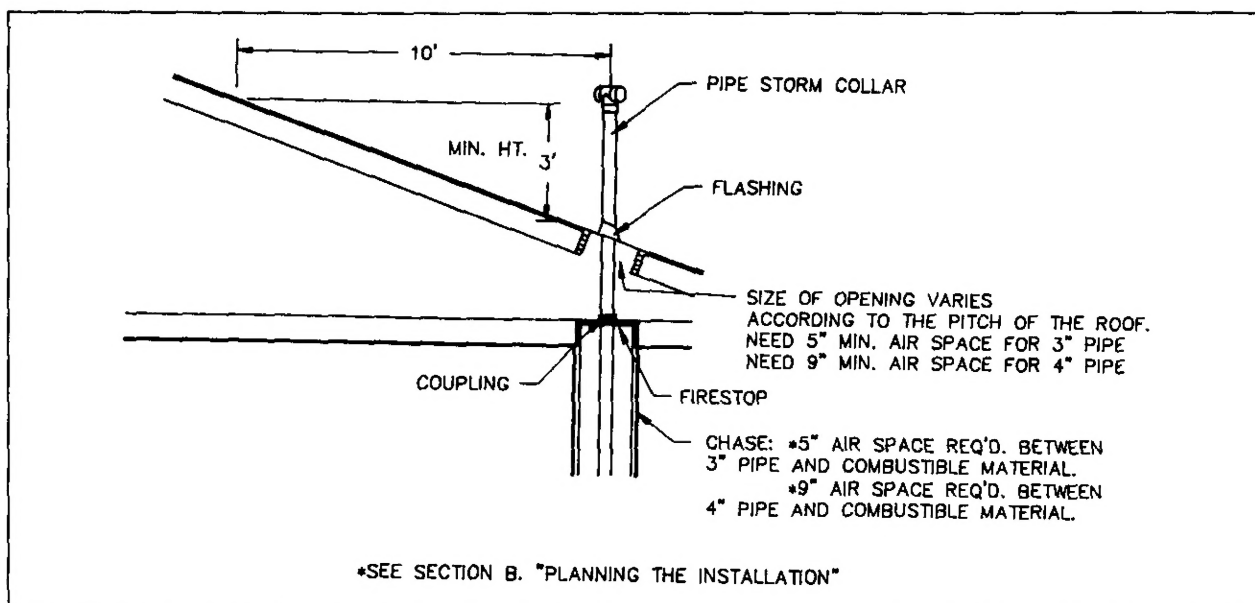


Figure 8

### B. Vent Termination

Only a termination tee with debris screen is allowed for vent termination. See Section D., Vent Termination Tee Installation for allowable termination tee.

**NOTE:** Terminating vent system with other than terminating tee can cause improper furnace operation. See Figure 8 for proper vertical vent termination.

Vent this furnace using these instructions, Installers' Information Manual and Part 7 of Current National Fuel Gas Code ANSI Z223.1/NFPA 54. Also, meet requirements of local utilities and other local code authorities.